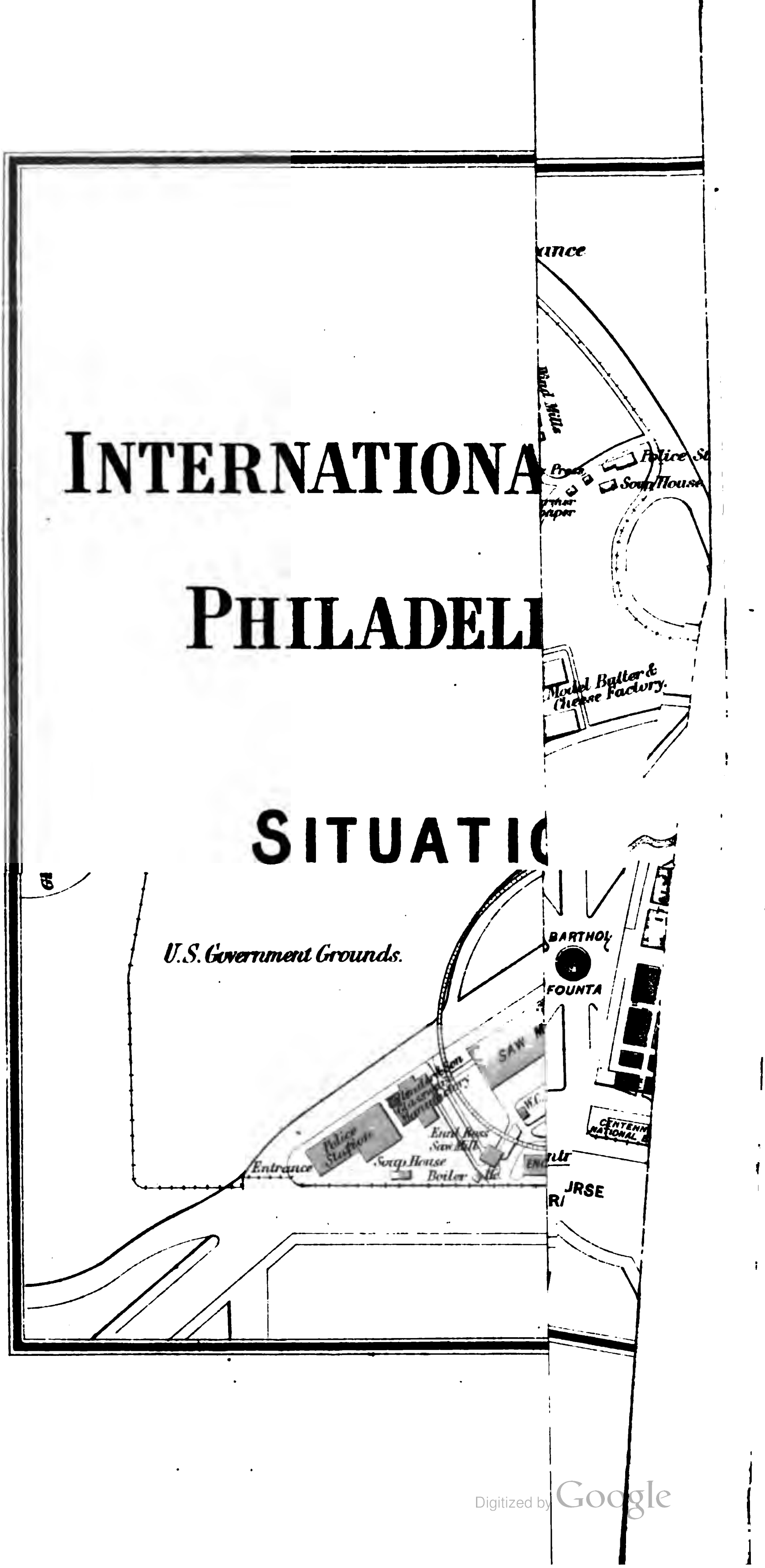
Part of Vol. 34, 1877


INTERNATIONA
PHILADELI
SITUATIO
U.S. Government Grounds.
Entrance
Police Station
Soap House
Boiler
SAW M
BARTHOL
FOUNTA
Model Butter & Cheese Factory.
Wind Mills
Soap House
JRSE

EDUCATION DEPARTMENT.

REPORTS

ON THE

PHILADELPHIA INTERNATIONAL EXHIBITION

OF

1876.

VOL I.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1877.

[C.—1774. *Price 5s. 6d.*]

Part of Vol. 34. 1877

CONTENTS.

ADDITIONAL EXHIBITIONS.

LITHOGRAPHS.

Report of the Duke of Richmond and Gordon, K.G., Lord President of the Council, to the Queen's most Excellent Majesty.

MAY IT PLEASE YOUR MAJESTY,

I HAVE the honour to submit to Your Majesty reports from the Executive Commissioners whom I appointed to represent me in America, and to direct, on behalf of the Education Department, the British Section at the late International Exhibition at Philadelphia.

Colonel Sir Herbert Sandford reports on the general administration of the Executive, and Professor Archer on the installation of the British Section.

The gentlemen who accepted my invitation to act for Great Britain and her Colonies as Judges have also favoured me with reports, on the respective merits of the contributions to the various departments of the Exhibition, on which, from their special attainments, they were, in concert with their Foreign colleagues, called upon to decide.

It will be found that in these reports most of the productions and manufactures of the British Empire are compared with those from other countries, particularly from the United States of America; and looking to the high qualifications of the British Judges in their several sections, I believe that their reports will prove to be of unusual and permanent value.

I regret that, as British Judges were not appointed by the American authorities for all the groups, a few classes of our section are not included in these special papers; but the general reports by the Judges of groups published by the Centennial Commissioners will deal with these exceptions.

A novel and interesting addition to the usual collection of documents, relating to the Exhibition, which I have the honour to lay before Your Majesty, is the series of reports with which I have been favoured from the Commissioners of the Dominion of Canada, and of the numerous British Colonies so admirably represented at Philadelphia.

I have to express my obligations to the three chief authorities of the Exhibition, General Hawley, President of the Centennial Commission, Mr. John Welsh, President of the Board of Finance, and Mr. Goshorn, Director General, for the most courteous assistance invariably received from them, and from their respective staffs, by all connected with the British Section. The cordiality with which our numerous requests were met could not possibly have been exceeded.

Your Majesty's Minister at Washington, from the beginning of our labours, rendered the greatest assistance in promoting the success of the British Section, and more particularly am I indebted to Sir Edward Thornton for the manner in which he represented this country at the various State ceremonies connected with the Exhibition.

I have also to express my obligations to Mr. Charles E. K. Kortright, British Consul for the State of Pennsylvania, Mr. Anthony J. Drexel, and Mr. George W. Childs, who very generously and zealously performed some of the duties which unavoidable circumstances prevented my having the pleasure of personally attending to in Philadelphia.

I wish to add my tribute of thanks to the universal sentiment of gratitude expressed in the United States to Your Majesty, to the Council of the Royal Academy, and to the other owners of pictures and statuary who so kindly lent their valuable property for the purpose of representing British Fine Art at Philadelphia.

I am glad to think that the collection of Works of Art, the most important ever contributed by this country to a Foreign Exhibition, was brought together, sent to and from America, and returned to the owners without any loss or damage.

I am afraid that, probably owing to the universal depression of trade last year, the efforts of British exhibitors to maintain the credit of their country at Philadelphia did not meet with so much immediate commercial success as I could have wished;

but I trust that the extended knowledge of British productions, which will result from this great Exhibition, will eventually lead to a large extension of trade between the two countries, to the advantage of both.

But in addition to the commercial view of an International Exhibition, its political aspect must always be more or less considered; and this more particularly in the case of the Philadelphia Exhibition, owing to the circumstances under which it was held.

It, therefore, affords me peculiar satisfaction to know that the action of Your Majesty's Government, and that of the Indian and Colonial Governments, and the efforts of our exhibitors, have been most successful in cementing the bonds of union between the two nations.

Sir Herbert Sandford quotes in his Report the eloquent address of Lord Dufferin, Governor-General of Canada, on this subject, and I have much pleasure in enclosing a copy of a letter I have received from the Foreign Office written by Sir Edward Thornton, in which he speaks strongly as to the good feeling between the two countries resulting from the part taken by Great Britain at this Exhibition.

I have also much gratification in submitting a copy of the resolutions lately adopted by the United States Centennial Commission and the Centennial Board of Finance, "expressive of their "appreciation of the very friendly interest manifested by Her "Majesty the Queen of Great Britain and Ireland, and Empress "of India, and Her Majesty's Government, in the International "Exhibition of 1876."

In conclusion, I wish to record my sense of the valuable aid I received in conducting the affairs of the British Section from Sir Herbert Sandford, to whose ability, tact, and energy much of the gratifying success of our Exhibition is due. Sir Edward Thornton and the American and Colonial authorities also bear the highest testimony to this officer's exertions.

Professor Archer performed his arduous duties as Executive Commissioner for Installation to my entire satisfaction.

I have to thank Mr. Trendell, Secretary to the Commissioners, for the manner in which he discharged his duties as head of the Secretariat, Delegate to the British Judges, and Compiler

of the Exhibitors' Commercial Guide, which forms part of the British Catalogue.

I also highly appreciate the excellent services, acknowledged by the Executive Commissioners, which were rendered by the four experienced Chiefs of Departments of the British Section, Mr. Thomas A. Wright (Industrial), Dr. John Anderson (General Machinery), Mr. J. M. Jopling (Fine Arts), and Mr. B. T. Brandreth Gibbs (Agriculture and Horticulture), as also by Mr. J. H. Cundall, Assistant General Superintendent.

The financial results of the management of the Vote for the British Section appear to merit special notice. The economy and efficiency with which this Vote has been administered are greatly due to the manner in which the members of the Staff performed their duties, and thereby enabled the Commissioners to carry out their work with the aid of a few but able and zealous assistants.

RICHMOND AND GORDON.

Privy Council Office, Whitehall,
May 7th, 1877.

Foreign Office,
November 29th, 1876.

Sir,

I am directed by Her Majesty's Secretary of State for Foreign Affairs to transmit to you, to be laid before his Grace the Lord President of the Council, a copy of a Despâtch from Her Majesty's Minister at Washington, giving an account of the ceremonies attendant upon the closing of the Philadelphia Exhibition.

I am, Sir,
Your most obedient humble Servant,
Tenterden.

The Clerk of the Council.

Washington,
November 12th, 1876.

My Lord,

Having been invited by the United States Centennial Commission to attend the ceremony of closing the Exhibition at Philadelphia, I considered it expedient to accept the invitation, and therefore went to that City on the 9th instant.

On that evening a dinner was given by the same Commission to the various Foreign Commissioners. To this I was also invited. The number of guests was about 250, and comprised many of the principal people of Philadelphia.

The President of the Commission, General Hawley, on giving the toast "The United Kingdom of Great Britain and Ireland and her Colonies" made some most flattering allusions to the assistance which had been given to the Exhibition by the great interest which had been taken in it by British Exhibitors.

The toast was received by all who were present with an enthusiasm such as I have never seen displayed during my residence in this country, and every time mention was made either of Her Majesty or of the British nation it elicited overwhelming applause: indeed, the United States Commission unhesitatingly admit that much of the success of the Exhibition was due to the assistance and countenance given to the enterprise by Her Majesty's Government and the British Exhibitors from the United Kingdom and from her Colonies.

On the 10th instant the Exhibition was formally closed by the President of the United States, the Diplomatic Body and the Foreign Commissioners being also present by invitation. The most marked attention was shown to the British Commission, and I have heard from the members of the United States Commission, and from all sides, the highest praise bestowed upon Colonel Sandford for the conciliatory manner in which he has transacted the business of the Commission, and for the friendly relations which he has maintained with the United States authorities.

The presentation of St. George's House by Her Majesty's Government to the city of Philadelphia has had the best effect, and I cannot but think that the part taken by Great Britain in the Exhibition, and the successful manner in which Colonel Sandford has carried out the objects of the British Commission, have contributed very efficaciously to the improvement of the good feeling between the two countries.

I have the honour to be,

My Lord,

Your Lordship's most obedient humble Servant,

E. Thornton.

The Earl of Derby,
&c. &c. &c.

International Exhibition,
1876.
United States Centennial Commission,
Philadelphia, February 21st, 1877.

Colonel Herbert B. Sandford, R.A.,
Executive Commissioner,
United Kingdom and Colonies,
London, England.

SIR,

WE have the honour to forward to you, for transmission to his Grace the Duke of Richmond and Gordon, K.G., Lord President of the Council, resolutions adopted by the United States Centennial Commission and the Centennial Board of Finance, expressive of their appreciation of the very friendly interest manifested by Her Majesty the Queen of Great Britain and Ireland and Empress of India, and Her Majesty's Government, in the International Exhibition of 1876.

With assurances of our distinguished consideration,

We are,
Yours very respectfully,
A. T. GOSHORN,
Director-General.

JNO. WELSH,
President,
Centennial Board of Finance.

INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876.

Whereas the United Kingdom of Great Britain and Ireland did, in response to the invitation of the President of the United States of America, not only graciously accept the invitation to participate in the International Exhibition to be held in commemoration of the separation from the Mother Country in 1776 of the States, then her Colonies, now the United States of America, but also for herself and on the part of her numerous Colonies exhibited the liveliest interest in it, and manifested the strongest sympathy with the people of the United States in all their ceremonies; and as it is our sincere desire to make suitable acknowledgments for the friendship thus shown; there-

fore, be it resolved by the United States Centennial Commission and the Centennial Board of Finance that our special thanks are hereby most respectfully and cordially tendered:

First. To Her most Gracious and Imperial Majesty Victoria, Queen of Great Britain and Ireland and Empress of India, the constant friend of the United States, for the loan of valuable works of art selected by her from her own galleries (which were objects of great admiration) and for many other evidences of her personal interest in the Exhibition.

Second. To the Government of the United Kingdom of Great Britain and Ireland, for the kindness and courtesy extended to the people of the United States of America by its participation in the International Exhibition.

Third. To his Grace the Duke of Richmond and Gordon, K.G., Lord President of the Council in charge of the Commission representing him at the International Exhibition, for the ability, energy, and devotion manifested by his Grace, which resulted in making his Department the crowning feature of the Exhibition.

Fourth. To Sir Edward Thornton, K.C.B., Her Britannic Majesty's Envoy Extraordinary and Minister Plenipotentiary to the United States, who as the representative of his Sovereign and country, manifested his deep personal interest in the Exhibition, and by his generous and hearty co-operation in all arrangements for its success, contributed greatly in making our Centennial Celebration an event equally glorious and honourable for Great Britain and the United States.

Fifth. To Philip Cunliffe Owen, Esq., C.B. (who in company with Colonel H. B. Sandford, R.A., was sent to Philadelphia in the earliest stages of the Exhibition,) for his aid to those who were intrusted with its management, in giving them the benefit of his extensive and varied knowledge and experience; for the encouragement derived by them from his intelligent appreciation of their purposes and capabilities in a work of such magnitude; for the kindly interest which he imparted to his fellow countrymen on his return home, which induced so large and varied a representation here of the arts and industries of his native land; and for the interest aroused by his personal efforts in several of the leading capitals of Europe.

Sixth. To Colonel H. B. Sandford, R.A., and Professor Thomas C. Archer, Executive Commissioners, who were charged with the

care and conduct of the British and Colonial Departments of the Exhibition, for the perfection which marked all their arrangements, for the varied and most attractive character of their exhibitions; for the propriety and good order which prevailed in their numerous sections, and for the satisfaction and pleasure which they in their official and private relations afforded to all with whom they were brought into contact.

Seventh. To the Commissioners from the several Colonies, who entered so earnestly into the spirit of the Exhibition, and so identified themselves with the people of the United States as to make it appear to the representatives of other races that the Anglo-Saxon, in whatever part of the earth he may be planted, is ever striving for that excellence which is alike beneficial to himself and his fellow-men.

Eighth. To the gentlemen of England who, with such unexampled liberality, selected the chief treasures of their art galleries, and at their own expense and risk placed them on our walls in the Exhibition, thus contributing works of the most illustrious artists to aid in forming a collection by ancient and modern masters hitherto unequalled in America.

Ninth. And to the gentlemen composing the staffs of the several Commissions of Great Britain and her Colonies, and also to the exhibitors for their constant, faithful, and effective attention in their several spheres of duty, which contributed so largely to the convenience and pleasure of the countless throngs by whom they were continually surrounded.

In witness whereof the United States Centennial Commission and the Centennial Board of Finance have hereunto affixed their respective Corporate Seals, duly attested at the City of Philadelphia the fifteenth day of February. A.D. 1877.

Seal of Board of Finance.

JOHN WELSH,
President.

Attest,
FRED. FRALEY,
Secretary.

Seal of Centennial Commission.

A. T. GOSHORN,
Director General.

Attest,
MYER ASCH,
Secretary to Executive Committee.

Downing Street,

SIR, 3rd April 1877.

I HAVE had the honour of submitting to the Queen the address of thanks from the United States Centennial Commissioners and from the Board of Finance, and I am desired to say how much the Queen is pleased with this address to Her Majesty.

I have also, on behalf of Her Majesty's Government and in my own name, to request that you will present our thanks to the Commissioners for the kind manner in which they have acknowledged our efforts to assist your late most successful enterprise.

It has given Her Majesty great pleasure to hear of the increased good feeling between the two nations which has resulted from the part taken at the Philadelphia Exhibition by Great Britain and Ireland, the Empire of India, and the British Colonies.

The address will be embodied in the report on the Exhibition which I am about to lay before the Queen, and to present to both Houses of Parliament; it has also been published for general information, and copies are being forwarded to all the gentlemen named therein.

I have the honour to be,
Sir,
Your obedient Servant,
RICHMOND AND GORDON.

A. T. Goshorn, Esq.,
Director General,
&c. &c.

5, Craig's Court, Charing Cross,
London, April 30, 1877.

MY LORD DUKE,

I HAVE the honour to make the following Report on the administration of the Executive appointed by your Grace to conduct the British Section at the Philadelphia International Exhibition of 1876. The Installation details are separately reported on by my colleague, Professor Archer.

Duties of British Commissioners at an Exhibition different in some respects from those of Foreign Commissioners.

The duties devolving on the British Executive at an International Exhibition are different in some important points from those which have to be performed by the Commissioners from other countries, and even from our own Colonies; the difference being caused by the small amount of assistance given on these occasions to individual Exhibitors by the British Treasury, as compared with that afforded in many instances by the Governments of other nations and of our Colonies.

This difference renders the responsibility of the British Executive lighter in some respects than that imposed on other Commissions, but in others greatly adds to their labours.

Points of difference.

Other Governments assist individual Exhibitors by granting bounties to enable them to make a good representation, or by collecting, forwarding, superintending, selling, or returning their exhibits* partly or entirely free of expense.

In such cases the responsibility of a Commissioner is great, but he acts on a large scale, as an individual Exhibitor, and one action or one decision covers ground which otherwise would have to be repeatedly gone over. Without entering into arguments as to the fairness to rivals in the same manufacture or trade, who do not exhibit, in affording such official assistance to those who wish to exhibit, it is sufficient for my purpose to state that such aid is not given by the British Treasury, except in special cases, such as in representing the Fine Arts of the country.

But the staff of the British section do render much assistance in other respects to Exhibitors, and the Commissioners have to satisfy the various wants and meet the different exigencies of hundreds of firms engaged in animated rivalry.

---

* I have to apologise to your Grace, as Head of the Education Department, for the use of this barbarous but almost indispensable word.

I propose, therefore, to state what this Executive have attempted to perform in furtherance of your Grace's instructions and wishes.

II. Official action on Invitation to Exhibit. On the 3rd of March 1871 the Government of the United States, by an Act of Congress, created the United States Centennial Commission to provide for "An International "Exhibition of Arts, Manufactures, and Products of the Soil and "Mine," to be held in the city of Philadelphia in the year 1876. By another Act of Congress, bearing date the 1st of June 1872, a Centennial Board of Finance was appointed to make the necessary arrangements for carrying out the objects of the Centennial Commission. These Acts of Congress were approved and confirmed on the 3rd of July 1873 by a Proclamation of the President of the United States, and on the 5th of that month the Secretary of State, Mr. Hamilton Fish, notified the same to the several Foreign Ministers at Washington.

Appointment of United States Centennial Commission and Board of Finance.

Invitations to Foreign Governments.

On the 5th of June 1874 an Act of Congress was approved extending invitations to take part in the Exhibition to Foreign Governments, and a formal invitation was forthwith sent to Her Majesty's Government through the usual channels; the general regulations for the guidance of exhibitors being issued in America on the 4th of July 1874.

Acceptance by Her Majesty's Government.

By Treasury Minute of 27th November the acceptance by Her Majesty's Government of the President's invitation was conveyed to the Foreign Office.

The Earl of Derby, in a letter dated the 3rd of December, intimated to General Schenck this acceptance, and expressed to His Excellency the hope of Her Majesty's Government that the Exhibition would fully realise the objects which the Government of the United States and the promoters of the Exhibition had in view. Lord Derby added that Her Majesty's Government had no doubt it would tend to the further development of the important commercial relations existing between Great Britain and the United States. On the 4th of December Lord Tenterden transmitted for your Grace's information, copies of all the correspondence which, up to that date, had passed on the subject of the Exhibition; and on consideration of these papers it was decided that the management of the British Section should be intrusted to the charge of the Lords of the Committee of Council on Education.

British Section put in charge of the Lords of the Committee of Council on Education.

This was a departure from the course of appointing a Royal Commission, hitherto pursued at Foreign International Exhibitions, and again adopted in the case of the Paris Exhibition for 1878; but with the advantage of the constant personal attention of your Grace, the executive work of the Commission can, it is believed, bear comparison with that of any previous Exhibition. It is true that the representation of the British Section during the Exhibition lacked the dignity which the presence of Royal Commissioners would have imparted, and that home duties did not

allow your Grace to visit the distant scene of the labours in which you took so warm an interest; but we were honoured by the cordial co-operation of Her Majesty's Minister at Washington, Sir Edward Thornton, who also most efficiently represented Great Britain on special occasions. Moreover the knowledge that we were working under the direct supervision of your Grace was of immense assistance to the Executive in all our transactions with the American authorities, all of whom highly valued the many proofs given by the Lord President of the Council, both individually and as representing Her Majesty's Government, of his earnest desire for the success of their national undertaking.

III. Organization of Executive Office. The following Executive Officers were originally appointed:—Mr. Philip Cunliffe Owen, C.B., the Director of the South Kensington Museum, as Commissioner; myself as Official Delegate, to represent the Education Department in America at such times as Mr. Owen, who retained the general supervision of South Kensington Museum, could not be present; and Mr. Trendell, a First Class Clerk in the Science and Art Department, as the officer in charge of the correspondence and accounts.

Appointment of Executive Commissioners and Secretary.

This arrangement was afterwards altered on the resignation of Mr. Owen on the 27th November 1876, when Professor Archer, Director of the Edinburgh Museum of Science and Art, and I were appointed Joint Executive Commissioners, and Mr. Trendell was made Secretary of the Commission.

The following gentlemen, who had great experience in former Exhibitions, were selected to act as Superintendents of the various Departments:—Mr. Thomas A. Wright, Industrial; Dr. John Anderson, General Machinery; Mr. B. T. Brandreth Gibbs, Agriculture and Horticulture; and the late Mr. Samuel Redgrave—succeeded on his resignation by Mr. J. M. Jopling—Fine Arts.

Of Superintendents.

A small and efficient staff were appointed, whose names will be found at page lxiv; all of whom, by their zeal and earnestness, have amply justified their selection.

And of Staff.

IV. Engagement of Subordinate Staff, and their Duties.* The Subordinate Staff were required for:—

1. Marking out allotments to be occupied by Exhibitors. Assisting in placing goods in their proper spaces. Mustering and superintending the labourers employed to expedite installation. General assistance throughout the Exhibition to Officers of Departments and to Exhibitors, and at the close of the Exhibition in removal of goods.

These duties were intrusted to a small party of Royal Engineers under the command of Sergeant Wright; they were performed most ably, and at this, as at all previous International Exhibi-

Royal Engineers.

* For names, see page lxiv.

tions, the services of the Royal Engineers have been invaluable. Belonging to a Regiment held in high honour in the United States, this detachment was on several occasions specially noticed and complimented. Sergeant Wright had, in addition, for some time, more important duties to perform, as Assistant in charge of the Installation Office in the Main Building.

2. Special guardianship of Exhibitors' goods, and prevention of unauthorised copies being taken of Exhibits.

Police.

The goods were in the custody of the Exhibition Authorities, who provided a body of police (the Centennial Guard) for the purpose. But experience at previous Exhibitions had shown that there were many occasions when the separate supervision of men belonging to the British Staff would be desirable, and even necessary. Your Grace accordingly sanctioned application being made to the Chief Commissioner of Metropolitan Police for the services of an Inspector and two Sergeants of his Force, and for assistance in selecting a detachment of men on the Police Pensioned List. This was willingly agreed to by the Authorities, and the services of the officers and men thus obtained were most valuable, both in performing strictly police duties, and in rendering general assistance. A detail of the duties performed by this Force, and other interesting information, will be found in the able report* of Inspector Hagen. We are much indebted to Colonel Henderson for selecting such efficient representatives of a body which has a world-wide reputation.

3. Assisting in the reception and installation of goods, in the work of cleaning during the Exhibition, and in packing, loading, and despatching goods at the close.

Mechanics and Labourers.

To enable the British section to be, as usual, ready on the opening day, and equally to the front at the close of the Exhibition, it was necessary to supplement the hearty endeavours of our Exhibitors by a certain amount of assistance, by the employment of manual labour, and of labour-saving machinery. This was more particularly necessary in the Machinery Department, where great weights had to be moved. All but the main passages in the different buildings had to be kept in order by the various Commissions, and a certain amount of assistance had to be given throughout the Exhibition in cleaning machines and show cases.

The following machinery and mechanical appliances were accordingly employed by the British Executive, and were manufactured and lent by the Firms mentioned.

Machinery and mechanical appliances used by the British Executive.

Cranes by Messrs. Appleby Brothers; traction engines and waggons by Messrs. Aveling and Porter; differential pulley, blocks, and hoists by Mr. J. Pickering; and hydraulic and screw lifting jacks by Messrs. Tangye Brothers, all of which were of the utmost use, and attracted great attention.

Boilers.

Three steam boilers with steel shells by Messrs. W. and J. Galloway and Sons. A "Donkey" force pump used for feeding these boilers by Mr. Frank Pearn; and a feed water heater used in connexion with the same boilers by Messrs. C. Green and Son.

---

* See page lxix.

The eight lines of main shafting in the Machinery Building were all set in motion by the great Corliss engine. But British (and some Foreign) machines which required steam for their motive power were supplied by the "Galloway" boilers and their auxiliaries. The American Executive provided a very handsome boiler house, and bore the greater part of the expenses connected with their setting, and keeping them in action during the Exbition. The loan of the boilers, which fully sustained, in the opinion of experts, the world-wide reputation of their manufacturers, has been, however, attended with great cost to the liberal owners.

The expenses attending the bringing over and return of these machines and auxiliaries, and of the engineers to work them, were borne by the British Commission.

Gangs of men engaged at Philadelphia, for the other manual labour above referred to, were superintended and assisted by picked men of the Royal Naval Reserve.

Experienced carpenters were also taken from England to assist in arranging the Fine Art and Government Collections, and for the performance of many other duties which constantly occupied their time during the Exhibition. Artificers.

The Exhibition Authorities were very liberal in their arrangements for the installation and removal of our goods, but we could not possibly have been, as we were, in such nearly complete array on the opening day, nor could we have wound up our closing operations in a manner to excite the admiration of a by no means slow-moving people, if the assistance above mentioned had not been provided to supplement the efforts so zealously made by our Exhibitors to be first in, and first off, the field.

V. Arrangements with the India and Colonial Offices; and communication with H. M. Colonial Commissioners during the Exhibition.

India.

The Marquis of Salisbury, Her Majesty's Secretary of State for India, nominated Dr. Forbes Watson, the Reporter on the Products of India, to confer with this Executive on points connected with the representation of the Empire of India at the Exhibition, and intimated that the Indian collection would chiefly consist of a representative series of raw products and of manufactures. It was arranged that, instead of having, as at Vienna, special Commissioners, the Indian collection should be entrusted to the care of this Executive, aided by a small staff.*

A very interesting display was thus made of articles from the India Museum, supplemented by the exhibits of three private firms, Messrs. Farmer & Rogers and Vincent Robinson & Co. of London, and by Messrs. Watson & Co. of Bombay.

The practical nature of the Indian collection was much appreciated by a practical people; and a request having been made by the Directors of the Pennsylvania Industrial Museum for the loan of the collection, Lord Salisbury was pleased to direct that the

* Page lxv, vol. I.

greater part of it should be lent for one year to that Institution, and eventually presented to such public Museum in the United States as I might recommend.

A Catalogue of the collection, with an introduction by Dr. Forbes Watson, will be found in Vol. II.

The Dominion of Canada.

On intimation of the intended Exhibition being given to the Government of Canada, the matter was warmly taken up, large grants were appropriated by both the Central and Provincial Governments, and a display was made of Fine Arts, raw produce, manufactures in all departments, horses and cattle, which excited the astonishment of even Canada's immediate neighbours.

A copy of the admirable report made by the Commissioners to His Excellency the Governor-General of Canada will be found in Vol. II., containing the Colonial Reports.

The Governor-General of Canada, Members of the Cabinet, Lieut.-Governors of Provinces, and many other leading men of the Dominion, headed the long list of visitors from Canada to the Exhibition.

It was agreed that the Commissioners should communicate directly with the American authorities; so that, as soon as the total amount of space which could be allotted to Canada out of the whole grant to the British Empire was settled, the Commissioners worked entirely independent of, but most harmoniously with, this Executive. The assistance we were enabled to give to the Canadian Commission by affording office accommodation, and the valuable services rendered by our Judges to that Commission, will be referred to separately.

I believe I am correct in stating that at no previous International Exhibition have the British Colonies been so numerously or so largely represented; and the efforts of these Colonies to make, in conjunction with Great Britain and Ireland, a display of the resources of the whole British Empire were worthy of this historical occasion.

Australasia.

Much as the Americans were struck with the exhibition made by the Dominion of Canada, the contributions sent by the great Colonies composing Australasia excited still greater admiration. The very interesting reports by the Executive Commissioners will be found in Vol. II.

Other Colonies.

Valuable reports relating to the collections from the Cape of Good Hope, the Gold Coast, Jamaica, Bermuda, the Bahamas, Trinidad, the Mauritius, and Ceylon are also given in Vol. II.

Eleven of our Colonies sent Commissioners to Philadelphia, the superintendence of the exhibits made by six* other Colonies being committed to this Executive.

The arrangements for allotting space to the Colonies will be found in Professor Archer's report. The communications of the Colonial Commissioners with the American Executive passed partly through this office, and were partly made direct.

---

* Mauritius, Ceylon, Gold Coast, Trinidad, Seychelles, Hong Kong.

All our intercourse was such as your Grace desired it to be, your staff being always ready to be of any possible assistance to the able and zealous gentlemen who so worthily represented their respective Colonies.

At this celebration of the national independence of England's oldest and greatest Colonies, the members of the Colonial Empire which the enterprise of her sons has called into existence joined together in exhibiting to admiring millions proofs, not only of vast material resources and rapidly developing industries, but of a most gratifying loyalty to the Mother Country, and I trust I may be pardoned for here quoting the eloquent address on this subject of the Governor-General of Canada, made by Lord Dufferin on his return to Ottawa from visiting the Exhibition; and also an address by the Colonial Commissioners to Her Majesty's Secretary of State for the Colonies, with Lord Carnarvon's reply.

Extract from the Earl of Dufferin's formal reply to an Address presented by the Corporation of Ottawa to His Excellency.

"In conclusion, gentlemen, I cannot help adding one "word of congratulation on the admirable appearance made "by Canada at the Centennial Exhibition, from whence I "have just come. Whether we take into account the "variety of our products, their intrinsic value, the degree "to which they are destined to promote the expansion of "our wealth, trade, and commerce, or whether we consider "the admirable method and completeness with which they "have been displayed under the supervision of our Com- "missioners, we must be equally struck with the effective "share which Canada has taken in enhancing the attrac- "tions of the Centennial show. There can be no doubt "but that these proofs of our resources, and prospects, "have made the most favourable impression upon our "neighbours in the United States. In many respects they "acknowledge, with a generosity which well becomes "them, that we are their masters, and the many prizes we "have taken away, especially in the agricultural com- "petitions, have completely borne out their appreciation "of our eminence; indeed I may say I am never allowed "to enter the United States without being made to feel "with what kindly feelings we are regarded by that great "people, whose own extraordinary development is one of "the marvels of the age. Wherever I go I never fail to "meet with the greatest courtesy and consideration, "which I gladly recognize as a tribute, not to myself, but "to the Canadian nationality I represent, whom the "people of the States are always anxious to honour in "my person. At no period in the history of the world "have those bonds of sympathy and affection by which "the members of the great Anglo-Saxon race are in-

" destructibly united, been drawn closer or rendered more " sensibly apparent than at the present moment. The " many proofs given by England of her friendly feeling " towards the people of the United States have found " their crowning expression in the noble way she has " associated herself with them in celebrating the Cen- " tennial year of their existence as an independent com- " munity, and nowhere has her Imperial dignity been more " fitly or appropriately displayed than beneath the lucent " roof of the Philadelphia Exhibition, where she sits " enthroned amid her native treasures, and surrounded " by the crowd of loyal colonies through whose interven- " tion she not only extends her sceptre to the four quarters " of the world, but has everywhere built up free institu- " tions, and laid deep the foundations of an imperishable " freedom. Facing her in generous emulation stands the " United States, backed by the wealth of her virgin " territories and the inventions of her ingenious artificers, " and as you traverse the building from end to end, you " almost forget to remember whether you be English, " Canadian, Australasian, American, from Africa, or from " India, in the proud consciousness that you are a member " of that great Anglo-Saxon race whose enterprise has " invaded every region, whose children have colonized two " continents, whose language is spoken by one-third of " civilized mankind, whose industry throngs the markets of " the globe, and whose political genius has developed the " only successful form of Constitutional Government as " yet known to the nations of the earth."

ADDRESS by the COLONIAL COMMISSIONERS.

SIR, Downing Street, 29th December 1876.

I AM directed by the Earl of Carnarvon to request that you will lay before the Duke of Richmond and Gordon the accompanying copy of a letter from the Foreign Office, enclosing a letter from the Colonial Commissioners at the International Exhibition in Philadelphia, expressing their sense of the services rendered to them by the British Executive Department.

8 Dec. 1876.

10 Nov. 1876.

29 Dec. 1876. I am to add that this letter has afforded much satisfaction to Lord Carnarvon, and I am to enclose a copy of a Circular Despatch which his Lordship has addressed to the Governors of the respective Colonies, expressing his sense of the services rendered by the Colonial Commissioners.

I am, &c.
R. H. MEADE.

To the Secretary of the
Education Department.

(Enclosures.)

The FOREIGN OFFICE to the COLONIAL OFFICE.

SIR, Foreign Office, 8th December 1876.

I AM directed by the Earl of Derby to transmit to you, to be laid before the Earl of Carnarvon, the accompanying letter, which has been received through Her Majesty's Minister at Washington, addressed to Lord Carnarvon by the Commissioners from the various British Colonies to the International Exhibition at

Philadelphia, conveying to his Lordship their sense of the courtesy and assistance which they have received from the British Executive Commission, and their Secretary and Staff, and the strong feeling of friendship which those Colonies entertain for the United Kingdom.

I am, &c.
T. V. LISTER.

The Under Secretary of State,
Colonial Office.

The COLONIAL COMMISSIONERS to the EARL of CARNARVON.

MY LORD, Philadelphia, 10th November 1876.

WE, the undersigned Colonial Commissioners at the International Exhibition in Philadelphia desire, before separating, to convey to your Lordship our sense of indebtedness for many courtesies and much valuable aid received from the British Executive, and from their Secretary and Staff, throughout the performance of our duties.

The attention so shown to us has both facilitated our independent action and well sustained that perfect unanimity which so happily prevails in every portion of Her Majesty's Dominions, and has thereby enabled us fittingly to manifest in this city, to the people of this country, and to its multitudes of foreign visitors, that, whatever may have happened one hundred years ago, the United Kingdom and the Colonies are now firmly joined in the closest bonds of friendship.

And we beg that your Lordship will favour us by causing his Grace the Duke of Richmond and Gordon to be duly informed of this record of our obligations, which we accompany with our hearty thanks.

We have, &c.
EDWARD GOFF PENNY,
Commissioner for Canada.
D. MACDOUGALL,
Commissioner for Canada.
AUGUSTUS MORRIS -
R. W. CAMERON -
R. W. FORBES - -
MARSHALL BURDEKIN -
JOSEPH J. PHELPS -
} Commissioners for New South Wales.
ANGUS MACKAY,
Special Commissioner for Queensland.
EDWARD Y. WEBB,
Commissioner for Bahamas, and acting for Commissions of New Zealand and Jamaica.
C. CRAWFORD COATES,
Commissioner for the Cape of Good Hope.
HENRY P. WELCH,
Commissioner for Tasmania.
REDMOND BARRY,
President of the Victorian Commission, per George Collins Levey, Secretary.
SAM. DAVENPORT,
Special Commissioner for South Australia.

The Right Hon. the Earl of Carnarvon,
&c. &c.
Secretary of State for the Colonies.

COPY of CIRCULAR from the Earl of Carnarvon to the Governors of Canada, N. S. Wales, Victoria, S. Australia, Queensland, Tasmania, the Cape, Jamaica, and Bahamas.

SIR, Downing Street, 29th December 1876.

I HAVE the honour to transmit to you the accompanying copy of a letter from the Foreign Office enclosing a letter from the Colonial Commissioners at the International Exhibition at Philadelphia, expressing their sense of the services rendered to them by the British Executive Department. 8 Dec. 1876. 10 Nov. 1876.

This letter has afforded the highest satisfaction to Her Majesty's Government, and I am charged to express their warm appreciation of the valuable labours of the Colonial Commissioners, which have so essentially contributed to the worthy representation of the British Empire at the Exhibition.

In compliance with the request of the Commissioners, I have with much pleasure communicated to the Lord President of the Council their acknowledgments of the assistance rendered to them by those members of his Lordship's Department who were employed at Philadelphia.

I have, &c.
CARNARVON.

VI. COMMUNICATIONS OF BRITISH EXECUTIVE WITH THE AMERICAN EXHIBITION ADMINISTRATION.

American Organisation.

The Exhibition was worked by three great Departments.

1. The United States Centennial Commission, consisting of two Commissioners from each of forty-seven States and Territories, from which body were selected a President, General Joseph R. Hawley, appointed by the President of the United States, five Vice-Presidents, and an Executive Committee of thirteen, of which Mr. Daniel J. Morrell was Chairman, aided by three Secretaries and a legal adviser.

2. The Centennial Board of Finance, consisting of a President, Mr. John Welsh of Philadelphia, two Vice-Presidents, twenty-two Directors, a Secretary and Treasurer, and a Financial Agent, assisted by three engineers and architects.

3. The Immediate Executive, headed by Mr. Alfred T. Goshorn, Director-General, himself a Vice-President and member of the Executive Committee, and seven Chiefs of Bureaus, Foreign, Installation, Transportation, Machinery, Agriculture, Horticulture, and Fine Arts.

United States Centennial Commission.

The general supervision of all arrangements was in the hands of the first-named Department, which, however, more immediately managed all the State and Public ceremonies, settled leading questions relating to the working of the Exhibition, and directly superintended the final questions relating to the awards.

Centennial Board of Finance.

The providing of Funds, the erection of the Exhibition Buildings, and the entire control of Finance questions were entrusted to the second department.

Director-General and Chiefs of Bureaus.

And the practical working of the Exhibition was managed by the third.

Mr. Alfred T. Goshorn and his indefatigable secretary, Colonel Myer Asch, were the gentlemen with whom most of our business was transacted, all our written communications, on whatever subject, having to pass through the hands of the Director-General as being in charge of the Foreign Department.

Valuable assistance received by British Section from Exhibition Authorities.

Your Grace has on several occasions borne public testimony to the obligations the British Section are under to the invariably courteous, ready, and zealous assistance rendered by the Director-General and his staff; to the very cordial and friendly manner in which your representatives and the British exhibitors were received by General Hawley, the President of the Centennial Commission; and to the great liberality shown by Mr. John Welsh, as representing the Finance Board, in the many concessions and

arrangements made by that Board, from which the whole British Section so much benefited.

Although all our correspondence passed through Mr. Goshorn's hands, yet we necessarily were frequently brought in personal contact with the other heads of departments and bureaus, and from one and all we never failed to receive the most prompt and kind attention to the requests and suggestions which, in the interest of our Section, we so frequently had to prefer.

Success of system of Organisation.

It might be naturally expected that with so very many different authorities the work of an Exhibition requiring in such numerous instances quick decisions and speedy action would have been much delayed; and, indeed, among the greatest proofs of administrative ability presented to us on the part of the Chiefs were the tact, unselfish devotion to duty, and desire above all things to make their great undertaking a national success, by which they overcame this great apparent difficulty, and thereby well earned the success which was undoubtedly achieved.

VII. Arrangements for giving General Information regarding the intended Exhibition, and Allotments of Space.

Circular letters announcing the intended Exhibition, with a copy and digest of the General Regulations, were sent to all the exhibitors in this country who took part in the Paris Exhibition of 1867, the Vienna Exhibition of 1873, and the London Annual Exhibitions of 1871, 1872, 1873, and 1874 (held under the direction of Her Majesty's Commissioners for the Exhibition of 1851).

Circulars to former Exhibitors,

On one of these papers, which contained a brief summary of the conditions upon which the Exhibition would be conducted, it was specifically stated that while the executive would do all in its power generally to assist and advise British exhibitors, it was necessary to bear in mind that they or their agents were responsible for the packing, forwarding, unpacking, and reception of goods as well as for their safety during the continuance of the Exhibition.

And to various Public Authorities;

Similar documents were also sent to all the Chambers of Commerce in the United Kingdom, and to the mayors of towns, with a request that such information might be communicated to manufacturers and producers who had not taken part in previous International Exhibitions, and the principal Metropolitan and local journals throughout the country also received copies of these papers; the result being that full details connected with the Exhibition became known through every possible channel to all those interested therein.

Also to Presidents of Fine Art Societies.

The Presidents of the Royal Academy, the Incorporated Society of British Artists, the Society of Painters in Water Colours, and the Institute of Painters in Water Colours were severally written to and requested to use influence with their

members to secure a worthy representation of British Art at the Exhibition.

And of Agricultural and Horticultural Societies.

The Presidents of the Highland Agricultural Society, the Royal Agricultural Society of Ireland, the Royal Botanic Society, the Botanical Society of Edinburgh, the Royal Caledonian Horticultural Society, the Royal Dublin Society, the Royal Horticultural Society, and the Royal Horticultural Society of Ireland, were respectively invited to afford the Commission the coöperation of their Societies in the agricultural and horticultural sections, and similar action was taken with the Presidents of the Architectural Association and the Royal Institute of British Architects in relation to the architectural section.

And of Architectural Associations.

Action on receipt of Applications for Space.

As applications for space were received the names of intending exhibitors were noted by the superintendents of the Industrial and Machinery Departments, Mr. T. A. Wright and Dr. Anderson, and when sufficient applications were received the allotments were provisionally made by those officers and mapped out by Sergeant Wright, R.E., and Mr. Ernest Cooper.

The representation by England in most of the departments of the Exhibition will be found mentioned in the reports on their groups, which the courtesy and public spirit of the gentlemen who acted as British Judges have enabled me to lay before your Grace. Other points regarding allotments of space are embraced in the report of my colleague, Professor Archer.

Plans drawn to scale showing the total space required by Great Britain and her Colonies in the various buildings were duly sent to the Director General at Philadelphia in accordance with the regulations, and each exhibitor received a coloured plan drawn to scale giving information as to his exact location, shape of space, abutting passages, principal frontage, and surrounding exhibitors.

Plans showing the actual space occupied by British exhibitors in the various sections of the Exhibition are appended to this report in a separate volume.

Prepared by British Staff and published by Her Majesty's Printers.

VIII. Catalogue and Exhibitors' Commercial Guide.

It was decided that the preparation of the catalogue should be part of the duties of the Executive Staff, and that it should be printed by Her Majesty's Printers, and it was arranged that in addition to the ordinary information contained in such works there should be a second volume, giving in full, in English currency, the United States Tariff of Import Duties upon articles of produce and manufactures, together with an epitome of American Laws relating to Patents and Trade Marks. This laborious work Mr. Trendell was authorised to prepare in other than official hours, and in order that he might have at his disposal exhaustive works of reference, the Foreign Office was requested to permit him to consult books in the Library and to have the advantage of the valuable suggestions of Mr. Hertslet on the subject. This permission Lord Derby was pleased to accord, and in addition, allowed the inspection of certain papers on cognate subjects printed for the use of the Foreign Office.

The volume in question, completed in February 1876, contained, in addition to an introduction by Mr. Trendell referring generally to the commercial interests of the two countries, an explanatory statement as to the United States Custom House Duties and Exchange; a subject index of contributions by British Exhibitors to the Exhibition together with the names and addresses of the manufacturers and producers; a list of articles of produce and manufacture admitted to the United States free of duty; a list of all articles chargeable with duty on being imported into the United States; the patent and trade mark laws; consular regulations, custom house fees, drawback rates and rates of fare; extracts from Post Office Acts as to "mailable" matter; and the tariff upon British goods imported into France, showing the rates prior and subsequent to the Paris Exhibition of 1855. The last paper was appended as a suggestive statement showing the influence exercised by one International Exhibition in the direction of a reduction of import duties. The "Exhibitors' Commercial Guide" has proved to be not only useful to our manufacturers generally, but it is believed will be found of value beyond the mere scope of the Exhibition, having been declared by authority to be a useful and standard work of reference, containing "information of an historical, financial, and commercial "nature which is pronounced to be thoroughly trustworthy." Exhibitors' Guide, edited by Mr. Trendell.

During the latter months of 1875 considerable advance was made in the preparation of the Catalogue under the able superintendence of Mr. H. Willoughby Sweny, Assistant Superintendent for Official Publications, who, besides writing the very exhaustive and interesting Introduction to the Catalogue, has been also of great assistance to the Executive in all the literary work connected with the Commission. As the applications for space were received the names of the Exhibitors and the proposed exhibits were set up in type, and were then classified and forwarded for correction and amplification to the firms concerned, who were at the same time requested to state to what previous Exhibitions they had sent goods and the several awards they had received. By this means the catalogue gradually took so complete a form that but little revision or arrangement was required to prepare it finally for press. It was ultimately completed at an unusually early date, and a large consignment of both volumes was sent out bound in paper and cloth, arriving some days before the opening of the Exhibition, together with a copy specially prepared for presentation to the President of the United States. Progress in preparing Catalogue.

Nothing connected with the British section was more favourably noticed in America than our catalogue, both as regards its contents and the general effect of the volume in printing and binding. A considerable number were sold, and many copies were presented to officials, public institutions, and libraries. To receive a British catalogue was considered one of the most appropriate compliments which could be paid, and the Press in the United States joined with individuals in giving high praise to this work. Success in America of British Catalogue.

IX. PREPARATORY VISIT TO PHILADELPHIA OF CHIEF OF STAFF.

In May 1875, Mr. Cunliffe Owen, accompanied by myself and Mr. Cundall, visited Philadelphia, there to establish the British Executive, and to make a personal inspection of the preparations for the Exhibition.

"American" Steamship Line.

We sailed in the American liner "Illinois," and thereby personally obtained much valuable information regarding the good qualities of this, the only American steamship line to England, and the great advantages, for Exhibition purposes, which this line possessed by running direct to Philadelphia, in connection with the Pennsylvania railroad, a branch of which great system connected the wharves with the Exhibition grounds.

Reception at Philadelphia.

This deputation being the first which crossed the Atlantic in connection with the Exhibition, and coming from a country on whose action it was allowed the success of the Exhibition so much depended, was received by the authorities, both of the City and Exhibition, with great distinction, and a most cordial welcome was given to their British visitors, with a display of friendship from all classes, which never slackened till the last day of our pleasant intercourse with the people of the United States.

Satisfactory result of visit.

As regards the main object of this visit, the result was most satisfactory, as showing to the experienced eyes of the Executive Commissioner that all the preparations for the Exhibition, both material and as regards the numerous essential regulations for the smooth working of Foreign Commissions, were in a very advanced condition.

Progress of Exhibition buildings.

It was manifest at this early date that there was every probability of the two principal buildings, the Main and the Machinery, being ready for the reception of goods before the goods were likely to arrive, which actually turned out to be the case. It was clear also that the novel and arduous undertaking of building in a short period a permanent structure for the reception of illustrations of the Fine Arts would be eminently successful.

Return of mission.

Having made several important and advantageous arrangements with the American Executive, Mr. Cunliffe Owen and the Official Delegate returned to England, Mr. Cundall being left in charge at Philadelphia, and specially intrusted with supervising the building of the British Offices and Quarters. During the following seven months, before the arrival of the Executive Commissioners, and also for some time after the final departure of the British Head Quarters from Philadelphia, Mr. Cundall had frequently important duties to perform, requiring great tact and involving heavy continuous labour. These he executed in a manner to earn the warmest commendation both from his immediate superiors and from the very observant American gentlemen with whom he was brought in contact.

Leaving local representative.

X. ARRANGEMENTS REGARDING THE REPRESENTATION OF FINE ARTS. It was originally intended that no special grant from public funds should be made for this department, a decision which threatened to deprive the British section of what eventually proved to be one of its most attractive features. On the occasion of our visit to Philadelphia we, however, reserved the right of Great Britain to a large space in the permanent building, now known as the Memorial Hall; and this foresight was fortunate. An important deputation, headed by the President of the Royal Academy, having waited on your Grace and the Chancellor of the Exchequer, and expressed the desire felt by the Royal Academy that the representation of British Fine Arts at the coming Exhibition should be worthy of this country, a formal letter was addressed to Sir Stafford Northcote calling attention to the fact that it had become evident that no private or commercial agency could secure a fitting representation of the British School, such as that advocated by the deputation, and urging the desirability of increasing the grant by 5,000*l.* for expenses connected with Fine Arts. The Treasury having consented to this addition, Sir Francis Grant was informed that Her Majesty's Government would defray the expenses of the collection and transport of paintings which might be selected by a Fine Art Committee from the works of British artists, at the same time a high appreciation was expressed of the generous aid offered by the Council of the Royal Academy, which extended not only to a representation of that body on the Fine Art Committee (of which the President consented to act as Chairman), but also to the offer of a selection from the Diploma Pictures as well as the cost of their insurance, which the Council volunteered to defray from its own funds.

Special grant by Treasury for Fine Art Exhibition.

The Fine Art Committee* was constituted on the 14th of September, and shortly afterwards commenced to hold its meetings in Craig's Court.

Appointment of Fine Art Committee and of Superintendent.

The late Mr. Samuel Redgrave was originally appointed Superintendent of Fine Arts, but on his being obliged to resign from ill-health, Mr. J. M. Jopling was nominated to the post. At that time Her Majesty had graciously announced Her intention of lending several pictures from the Royal Collections, in addition to the selection from their Diploma pictures promised by the Council of the Royal Academy. But, though the scheme of selection was well laid out by the Fine Art Committee, very few other pictures had been secured.

Loan of Pictures by the Queen and by the Royal Academy.

This Committee, which contained among its members some of the first artists of the day, devoted much of their valuable time to perfecting a scheme, whereby, if the owners of the works of art selected would lend their property for the purpose, a complete representation of deceased and living English artists would be secured.

Work of Fine Art Committee.

The merits of all deceased English artists who have flourished within the last century were considered, certain artists were pro-

* Names given on p. lxv.

nounced worthy of representation, and the number of each artist's works (taking four as the maximum) was decided upon according to order of merit. Finally the particular works were named for the loan of which application should be made.

A similar course was pursued with living artists, except that each of those selected was asked to name the works by which he, or she, would wish to be represented.

Requests for loan of Pictures and Statuary.

Letters were then addressed by your Grace to the owners of all works named, informing them that, excepting sculpture, for the insurance of which they would not be responsible, the Government would defray the entire expenses, including insurance, connected with the Exhibition of any works lent.

It was felt that to ask owners to part, for nearly a year, with treasures, in many instances priceless; to allow their property to run the risk of damage, even from unavoidable causes, in packing and unpacking, travel by land, long sea voyages, and exhibition under conditions not very well understood, was putting to a great trial even those lovers of art who show their devotion to it by giving to others opportunities to share their pleasure.

Responses as regards works of deceased Artists,

It was not, therefore, surprising that the applications for the loan of works by deceased Masters were not very favourably responded to; but nevertheless, in consequence of the example set by Her Majesty the Queen and by the Council of the Royal Academy, a certain number of very valuable works were lent.

And of living Artists.

With the works of living artists we were more successful, and by far the largest and finest Fine Art Collection which has ever left these shores was entrusted to the care of the Executive.

Valuable Collection secured.

The mere money value of these works may be estimated from the insurance effected, which amounted to nearly 200,000*l.* This does not include the sculpture, of which, in addition to the valuable busts lent by the Royal Academy, one very remarkable piece, the late Mr. Gibson's Venus, was liberally lent by Mr. Richard C. Naylor.

Assistance from Superintendent in securing this Collection.

A great deal of secretariat work was involved in these transactions, and Mr. Jopling's previous experience in Government employ was here of great service, while the confidence felt in him by many artists and owners of works of art was also of great use in obtaining the loan of valuable pictures.

Reception and packing of Pictures at South Kensington Museum,

A due representation of British Fine Arts having been secured, measures were taken for collecting and packing the same at South Kensington Museum, where, under the able supervision of Mr. Richard Thompson (now acting director of the Museum), the services of the experienced and trained Museum staff were employed for the purpose.

And in North of England.

Some of the pictures, however, which were lent in the north of England were collected and packed by Mr. Agnew, himself the lender of several valuable works; or, as in the instance of the Corporation of Liverpool, who were good enough to lend two fine paintings, were packed by the owners at the port of embarkation.

Arrangements were made with the Midland Railway Company to take the collection in the same vans from the Museum alongside the steamship at Liverpool, by which means the least possible risk in handling was secured.

Arrangements for Railway transport.

The selection of the line of ships by which to send the collection was an anxious matter, as if a company were chosen not very generally known to the public, and a mishap occurred, the Executive would naturally be blamed. The advantages offered, however, by the American Steamship line, both on account of their running direct from Liverpool to Philadelphia, and also from the special accommodation proffered by Mr. Spence, their agent, who put at our disposal the excellent intermediate passenger compartments below the saloon, coupled with the experience personally gained on the preparatory visit to Philadelphia already noticed, decided our entrusting this valuable consignment to a line of, comparatively speaking, new standing. The result justified the decision, as the work could not have been better carried out than it was by the American Company.

Selection of Steamships.

The collection was sent by two successive steamships, Mr. Jopling personally superintending the railway transit and embarkation, and accompanying the second consignment to America.

On arrival at the Philadelphia Wharf, special trains were provided, by direction of Colonel Scott, the President of the Pennsylvania Railroad Company, the track was cleared, men were stationed along the line, and both consignments were taken with speed and every precaution to the entrance of the Fine Art Galleries.

Arrangements on arrival of Collection at Philadelphia.

We had previously secured ample space in the permanent building now known as the Memorial Hall, the American Executive having at my urgent representation, given us several rooms in this building in addition to our previous allotment, in lieu of three courts previously reserved as part of our space in the Fine Art Annexe, a building which was not fire-proof.

Allotment of Galleries in Fine Art Building.

At Mr. Jopling's suggestion an important change was made in the main galleries, whereby very much improved exhibiting space was secured on the screens which served as partitions. Mr. Cope, the British Judge for Fine Arts, testified in an official letter to the admirable manner in which Mr. Jopling, who was assisted by experienced workmen specially brought from England, hung the British pictures, to which, as will be seen from his Report, Professor Archer also bears witness. I may add that the skill and artistic taste displayed by Mr. Jopling were most warmly acknowledged and commented upon both by connoisseurs and by the press.

Hanging of Pictures by Superintendent.

There was no portion of the British section, popular as was the whole department, which created so much enthusiasm and called forth such warm acknowledgments on the part of the Americans as our Fine Art Exhibition. It was known that its contents were sent over not for purposes of sale, but out of good will to the nation, and many were the friendly responses made to the kindly feeling of the lenders of so much precious property. The British

Popularity of British Fine Art Exhibition.

Galleries were always crowded, often very inconveniently so, but no damage whatever was done by any of the millions* who passed through them during the Exhibition.

Arrangements for safety of Collection during Exhibition.

In addition to the guards lent by the Central Executive we had special members of the metropolitan police, accustomed to the care of pictures, to assist in the galleries. Two guardians had to be stationed beside Mr. Frith's "Marriage of the Prince of Wales," lent by Her Majesty the Queen, in consequence of the great popularity of the picture.

Return of the same at close of Exhibition,

At the close of the Exhibition the greatest efforts were made to secure the safe and quick despatch of the collection. Mr. Jopling superintended the packing by trained London men; the Custom House authorities, by particular directions from Washington, waived all formalities; the railway company again made special arrangements; the American steam ships afforded, as before, their best accommodation; and, within four weeks from the close, half of the pictures were at Liverpool, the remainder following a week later. Special trains and vans, provided by the Midland Railway Company, took the collection from the Liverpool Docks to the South Kensington Museum, and most of the works were with their owners before Christmas.

In excellent order.

Many very satisfactory letters have been received as to the condition in which the pictures were returned, one gentleman of great experience declaring that from no previous exhibition, home or foreign, had he ever received pictures in better order. The whole of our claims on the insurance office, and these chiefly for gilding frames, was under 34*l.*

Erection of three British Buildings in Fairmount Park.

XI. PROVISION OF OFFICIAL ACCOMMODATION FOR THE BRITISH STAFF AT THE EXHIBITION. The question of the most expedient manner in which to house the staff of the Commission having been considered, it was directed that the plan adopted on the occasion of the Vienna Exhibition of 1873 should be carried out on a somewhat enlarged scale, and that buildings should be erected in Fairmount Park which might be available as Offices for the Executive and dwellings for the junior staff. It was further decided that these Commission houses should be of a style of domestic architecture which would represent a period common to the history both of the English and American people. †Architectural plans for the three British houses, known afterwards as St. George's House, the Barracks, and the Workmen's Quarters, were prepared by Mr. Thomas Harris and taken to Philadelphia on the Commissioner's preparatory visit. As already mentioned, Mr. Cundall was left in America specially charged with supervising the building of these houses, the contract for which was taken by Mr. Rice of Philadelphia.

---

* The total attendance of visitors, paying and free, at the Exhibition was 9,910,966, and the Memorial Hall was the building of greatest resort in the grounds.

† See plans in appendix to report.

The tiles and chimney shafts for St. George's House were supplied by Messrs. Eastwood & Co., the other material for the exterior was provided by the contractor.

The interior decoration and furniture of the houses, particularly of St. George's House, were provided by the following firms, and are referred to in detail at pages 79 to 90 of the British Catalogue:

Decoration and furnishing of Houses.

Messrs. Barnard, Bishop, and Barnards.
Messrs. Cooper and Holt.
Messrs. A. B. Daniell and Son.
Messrs. Henry Doulton and Co.
Messrs. Elkington and Co.
Messrs. H. and J. Gardner.
Mr. John Lewis.
Messrs. Minton, Hollins, and Co.
Messrs. Stewart, Moir, and Muir.

Mr. Jopling also contributed a selection of his water colour drawings, and Messrs. Henry Graves and Co. engravings for the embellishment of the building.

St. George's House.

To the taste of Mr. Henry Cooper we are indebted for the artistic manner in which St. George's House was fitted up, which repeatedly called forth the admiration of our numerous visitors. Mr. Cooper went specially to Philadelphia to superintend the decoration and furnishing, and was awarded a medal and diploma by the Judges for this marked proof of his zeal and capability.

Arrangements were made for hiring a furnished house in the immediate vicinity of the Exhibition as a residence for the principal members of the staff, by which provision we were able to reserve St. George's House for public purposes, and to offer office accommodation to the Commissioners from the Dominion of Canada and from eleven of our Colonies, besides providing room for our own Secretariat.

Great number of visitors.

The three reception rooms were also of much use both on special occasions and as show rooms to our visitors. For even before the opening of the Exhibition, it became evident that St. George's House would be one of the chief points of attraction, and it was necessary to make regulations to enable as many as possible of our American friends to view the interior without disturbing the conduct of business. Books of passes were, therefore, distributed among the leading officials to use at their discretion, a pass admitting any number, and admission was also granted on presentation of visiting cards. Some idea of the numbers who took advantage of these arrangements may be formed by the fact that the issue of these passes amounted to 13,000, which, independently of the very large number who entered by leaving cards, must have reached an aggregate of at least 30,000 visitors.

Presentation of St. George's House to the City of Philadelphia.

There was but one voice throughout the United States in praise of this House and its contents, and never was a national gift more appreciated than when with the approval of the

Queen, and in the name of Her Majesty's Government, St. George's House was presented to the City of Philadelphia, a gift which has been acknowledged by a Resolution of Thanks from the chief authorities of the City, of which the following is a copy :—

"RESOLUTION OF THANKS TO HER BRITANNIC MAJESTY'S GOVERNMENT.

"Whereas the Government of Great Britain having by His Grace the Duke of Richmond and Gordon, K.G., presented to the City of Philadelphia the building erected at Fairmount Park for the use of the Commission during the International Exhibition, known as St. George's House:

"It is therefore resolved by the Select and Common Councils of the City of Philadelphia, that the same be accepted as an expression of good will and kindly feeling to this Municipality, and that the building be carefully preserved as a memorial of the broad and liberal spirit which prompted the gift, and as an enduring monument of the auspicious part taken in the International Exhibition, 1876, by the United Kingdom and Ireland; the Dominion of Canada and British Colonies; and the Empire of India. Attested.

JOSEPH H. PAIST, Clerk of Select Council.	JOSEPH L. CAVEN, President, Common Council.
JOHN ECKSTEIN, Clerk of Common Council.	GEORGE A. SMITH, President, Select Council.

"Approved this fifteenth day of December, A.D. 1876.

(Sd.) WILLIAM S. STOKLEY,
Mayor of Philadelphia."

Allotment of Space.

XII. QUESTIONS WITH THE EXHIBITION AUTHORITIES REGARDING ALLOTMENT OF SPACE, ADMISSION FACILITIES TO EXHIBITORS, AGENTS, AND EMPLOYÉS, TERMINAL CHARGES, AND STORAGE OF EMPTY PACKING CASES.

The space originally allotted to Great Britian, India, and the Colonies in the Main Building was, at your Grace's request, nearly doubled, and one of the results of our visit to Philadelphia above referred to was the re-arrangement of this space so as to give the British and Colonial Sections a commanding central position, securing a double frontage on the main avenue and on the transept.

Liberal allotments of space were made to these Sections in the other buildings, but many details had afterwards to be arranged on the spot by Professor Archer, the Executive Commissioner charged with the Installation.

Carriage Annexe.

The display of carriages at previous International Exhibitions has always constituted a difficulty to the Central Executive, it being a moot question whether they should be shown in the Industrial or Machinery departments. This difficulty was met at

Philadelphia by the construction of a separate Annexe, in which the greater portion of the carriages of all nations were brought together. This Annexe was situated in a part of the grounds of such general resort that the objections which might otherwise have been urged against the separation of the carriages from the main body of the exhibits did not in this instance apply. The space allotted to the British carriages was very prominent; and the display made by some of our best builders, such as Messrs. Peters & Sons, Messrs. Hooper & Co., Messrs. Mulliner, Mr. Windover, Messrs. McNaught and Smith, Messrs. Roberts, and Mr. Thorn, did ample justice to it.

Admission to Exhibitors, &c.

The arrangements for free admission to those entitled to the privilege were on a liberal scale, but made so as to prevent abuse as much as possible. The plan of having photographs of persons thus entitled printed on their passes was carried out with success; and in this, as in other Regulations there were no vexatious changes made by the American Authorities during the Exhibition, but the rules and forms originally issued were adhered to throughout.

Terminal Charges, and arrangements for reception of goods at Exhibition.

The American Executive undertook to receive Exhibitors' goods at the entrance of the grounds, to convey them to the space allotted to each Exhibitor, and at the close of the Exhibition to remove the goods from the said spaces to the spot where they were originally taken charge of. To carry out this arrangement, lines of railway led from the outer gates either to sidings at the nearest entrance of each building where the goods had to be deposited, or as in the case of the Machinery and Agricultural Buildings, into the buildings themselves. Locomotive engines were constantly employed by the Executive in moving great trains of trucks which had been delivered into the enclosure by the Pennsylvania Railroad from all parts of the United States. Two of Messrs. Appleby Brothers cranes, and one of Messrs. Aveling and Porter's engines, with English engine drivers, were brought over by us at the expense of the American Authorities to assist generally at the installation and removal of goods. Large gangs of men were also employed to unload the cases, and put them on their owners' spaces.

For the performance of this work certain charges per package and according to weight were originally fixed upon. But when this scale of charges was received in Europe very great dissatisfaction was expressed, chiefly as regards the expense which would be incurred by owners of heavy goods. On receiving strong protests against this scale, the American Authorities reduced the charges by one half. When the goods began actually to arrive the Authorities, however, most liberally remitted the whole of these "Terminal Charges," and effectually carried out, gratis, the work they originally undertook to perform for payment.

Storage of empty packing Cases.

Connected with Terminal arrangements and charges was this question: whether, as at some Exhibitions, the Authorities should take charge of the empty packing cases, or whether, as at others, the Foreign Commissioners or the individual Exhibitors should be left to make their own arrangements?

The matter was an important one, in connection with the speedy installation of the exhibits, and the early removal of goods after the close of the Exhibition. For the great accumulation of packing cases* which would take place in the buildings if good arrangements were not provided for their speedy removal, would necessarily obstruct all other work; and similarly at the close, if the packing cases were not quickly returned to Exhibitors great delay would obviously be caused.

The Authorities decided to leave it optional to Exhibitors whether to commit the cases to their charge or to make private arrangements, and some, particularly Americans, preferred the latter course, but the great majority of the cases were given in charge of the Exhibition Executive. For the storage of these cases numerous sheds were erected in a large field adjoining the Exhibition grounds, and a line of railway ran from the grounds between the ranges of sheds.

Considering the immense number of empty packing cases thrown almost simultaneously on the hands of the Authorities in all parts of the extensive Exhibition grounds, and remembering the necessity there was for removing this great mass in a very limited period, the work was as well executed as could have been expected.

The buildings were cleared, and the cases were removed; but there was at first great disorder in the packing case depôt arising from the manner in which the cases were stored.

At a very early period of the Exhibition I drew the attention of the Authorities to this matter, forwarding an able report made after personal inspection, by one of our staff Mr. Ernest Cooper, whose experience at the Vienna Exhibition led me to select him for the performance of what, I lament to say, was his last public duty, a fatal attack of fever soon afterwards depriving the Commission of the services of a very promising and most estimable young man.

Fire in Empty Case Depôt.

I continued to press the subject till, as noted in Inspector Hagen's† report, a fair systematic arrangement of the cases was made. Fortunately I succeeded in having the valuable cases belonging to the British Fine Art collection put in a separate shed, and completely boarded in; for, as reported by the officer last named, a fire destroyed 4,528 packing cases, including 1,240 British; and the isolation of the shed containing our picture cases enabled the Fire Brigade and our Engineers and Police to save property, to us, of very great importance. But this fire, I regret to state, involved some of our Exhibitors in considerable expense, re-imbursed in many instances, however, by the Fire Insurance Offices.

Return of Cases at close of Exhibition

At the close of the Exhibition every measure was taken to expedite the delivery of the old and the newly made cases to our Exhibitors, and these were, in fact, delivered as quickly as the Custom House formalities permitted the goods to be packed.

* There were 154,273 packages received, 7,385 being British and Colonial.

† Page lxix.

Messrs. Aveling and Porters' traction engine and its train were of great use on this occasion, and it was publicly commented upon, that while the President of the United States was in the act of closing the Exhibition by stopping the great Corliss engine, the waggons containing the first consignment of English Fine Art packing cases were being piloted through the crowds in the grounds.

XIII. NEGOCIATIONS WITH VARIOUS STEAMSHIP COMPANIES AND RAILWAYS FOR SPECIAL RATES OF PASSAGE MONEY FOR EXHIBITORS, &c., AND FREIGHT OF GOODS.

These were commenced at an early date, at first through Messrs. Cook and Son, who rendered such valuable assistance to the Royal British Commission during the Vienna Exhibition, and afterwards direct with the Companies.

There were twelve steamship lines, which it was thought would be used more or less by our Exhibitors, and eight* of these made special reductions on single or return fares for the Staff, Exhibitors, and their assistants. Special fares granted by eight Steamship Companies.

Arrangements were made whereby, on application to this Office, Exhibitors wishing to avail themselves of the privilege received certificates, copies of which were also forwarded to the Steamship Company selected, thereby guarding the Companies against any abuse of their concession, and advising them of the accommodation required in particular ships. Under these rules our Exhibitors took 234 passes, first and second class. Method of Exhibitors obtaining reduced fares.

Some of the Steamship Companies offered special rates of freight outward for Exhibition goods, and of these, four† retained the same rates for return goods. Special Freight rates.

The latter was a valuable concession to our Exhibitors, for in the winter months, the time of returning unsold goods, there is always a very large demand for tonnage to convey provisions of all kinds from America to Great Britain, and freights rule high in comparison with those taken from Great Britain to America. Ditto for Return goods.

The production of the Executive Commissioner's certificate, stating that the goods were for the Exhibition, and the official label with the Union Jack, supplied from this Office for every package, vouched for the goods thus privileged. There were 915 certificates thus issued for 3,810 packages of goods. Mode for obtaining these reduced terms.

A great portion of the exhibits went out by the American line to Philadelphia, this line not only offering very moderate terms, but also, by its connection with the Pennsylvania Railway, which has a line between the Exhibition Grounds and the wharves, being able to make one charge between London or Liverpool and the spot where the Terminal Agency took charge of the goods. Route generally chosen for transit of goods.

* The American, Anchor, Guion, Great Western, North German Lloyd's, State, White Star, and Wilson.

† The American, Anchor, Inman, and Wilson.

Some of our goods however went viâ New York or viâ Baltimore, for which special railway facilities were also made.

But in returning to England the great bulk of our goods have come by the direct American line, the advantages which the line offered for this purpose having been fully appreciated.

XIV. Arrangements with the United States Treasury in connection with Invoices of Goods.

According to the usual custom a declaration was required to be made before a Consul of the United States for each consignment of goods sent to Philadelphia. This formality, irksome enough in London and our large towns, as involving much loss of time to busy men, was likely to prove still more detrimental to exhibitors who resided at a distance from the station of a Consul, and threatened to deprive us of some of our most interesting exhibits.

Usual custom very irksome for Exhibitors.

At first, on remonstrating against this rule, an apparent concession was made, allowing the declaration to be signed before the Executive Commissioner, if empowered to administer an oath. But the Commissioner had not this power, and even if he had, the remedy, as regards our numerous Exhibitors not resident in London, was far from being a cure. On my representing this grave difficulty, Her Majesty's Secretary of State for Foreign Affairs requested Sir Edward Thornton to bring the matter before the Secretary of the Treasury at Washington, who thereupon allowed the Executive Commissioner's Certificate to be received at certain ports of the United States as a sufficient guarantee that goods were destined for the Exhibition.

Special concession granted by United States Treasury.

This concession was also extended to all Foreign Commissions.

This was the first of many acts of courtesy on the part of the Treasury Authorities at Washington, who throughout the period of the Exhibition showed every desire to mitigate the inconveniences which the due enforcement of a heavy and wide spread tariff necessarily entailed on the British Staff, our Exhibitors, and their Agents.

XV. Removal of British Head-Quarters to Philadelphia, Condition of Grounds and Buildings, Arrival of Goods, Appointment of British Agents.

In describing the action taken on each subject I also report upon most of our proceedings in America which it is wished to bring to your Grace's recollection, but I would add under the present heading a few details.

Removal of British Head Quarters to Philadelphia.

With the exception of those whose services were required to look after the interests of our Exhibitors in England, the Executive left London in January and February 1876, Professor Archer first starting with the staff whose more immediate duties related to the installation, and I following with part of the secretariat, the finance, and India establishments. By the end of

February, 50 members of the British Executive Staff were housed within or in the immediate neighbourhood of the Exhibition grounds.

Condition of Buildings and Grounds.

A change, such as can only be seen in America, had come over the locality since my visit nine months previously. Not only were the great* buildings, whose outlines were then almost all that was to be seen, complete, but many smaller buildings had sprung up and were more or less finished. The number of buildings within the grounds was eventually nearly 200.

The grounds themselves, on which I had left hordes of men busily employed, had taken form and shape and gave promise of the beautiful aspect which the summer produced. The Railway, which made a circuit of the grounds and which was of such use to the public† during the Exhibition, was nearly ready; it began running immediately after the opening. Lines of railway for goods traffic entered the buildings and traversed the grounds in various directions, and already the "Centennial" locomotive engine was busily employed.

Outside the grounds, where I had left a few scattered buildings, were now arising lines of streets composed of houses, more or less substantial; several immense hotels, which afterwards proved none too commodious for the wants of the multitude of visitors, were outwardly ready; and handsome broad roads, which will permanently greatly improve the vicinity, were under rapid construction.

The Pennsylvania Railroad Company, by whose system most of the distant visitors to the Exhibition travelled, was erecting large passenger stations, one immediately opposite the main entrance to the grounds, and one in the neighbourhood, the tracks for the incoming and outgoing trains at the former being constructed in the form of a circle, thereby securing a continuous ‡arrival and departure of trains.

First arrival of Goods.

The goods of several foreign nations were already within the main and machinery buildings, and one of the first duties we had to perform was with reference to the reception and installation of goods, some Colonial and some British, consigned to no particular agent.

Appointment of general British Agents.

Messrs. Peter Wright and Sons, one of the first firms in Philadelphia, here offered their services, which were gladly accepted, both as general agents for the British Executive and also as agents wherever the appointment of such was left to our discretion. This firm possessed one great advantage in being the agents for the American Steam Ship Company, one of the partners, Mr. Clement Griscom, being manager of the line, by which all British Government property and much of our exhibitors' goods were arriving. Messrs. Peter Wright and Sons organised a special Agency Department, and we allotted to them a space for an office next to the Executive Commissioner's Office in the Main Building.

---

* For engravings of elevations and plans, see after page lxxvi.

† 3,812,794 passengers used this Railway during the Exhibition.

‡ During the six months of the Exhibition 42,603 trains with 268,580 railway carriages, containing 4,955,712 passengers, arrived at these two stations.

Great assistance received from Agents.

This firm have amply justified their special appointment. Throughout the installation, the Exhibition, and the closing scenes, their services have been invaluable, and since the departure of the last English representative from Philadelphia, Mr. Cundall, they have been good enough to act as our agents, in several matters requiring local assistance.

XVI. SETTLEMENT OF VARIOUS QUESTIONS WITH THE CUSTOMS AUTHORITIES RELATING TO EXHIBITORS INVOICES, THE SALE OF DUPLICATE GOODS, COMPLETION OF SCHEDULES, AND OBTAINING EXPORT PERMITS.

The great difficulty at the Philadelphia Exhibition was with the Custom House Regulations, and this not so much from any desire on the part of individual officers to obstruct the working of a vast undertaking which otherwise ran so smoothly, but owing to the necessity for carrying out the provisions of a tariff embracing almost every article brought for exhibition.

I have already (para. 14) alluded to the initial difficulty which threatened to prevent the export of many British goods, and to the desire shown on the part of the chief revenue authorities to make the rules as little irksome as possible.

Difficulties on landing of goods.

But other difficulties arose, for when the consignments had arrived at their American port the regulations exacted transportation entries if at New York or Baltimore, and warehouse entries if at Philadelphia. Hence there was great delay in obtaining permits for forwarding the goods, though in bonded cars, and destined to a bonded warehouse.* Again when the goods had arrived in the grounds, the regulations required the cases to be opened and examined before they were admitted within their destined buildings, and a large shed was built by the Board of Finance for this purpose; and—when the cases were at last placed on their assigned spaces, the rules declared that every article, as it was unpacked, must be checked and appraised by Custom House officers.

On arrival at Exhibition.

And on proceeding to unpack.

These difficulties threatened greatly to retard the efforts of your Grace's Executive to secure the punctual instalment of the British exhibits. But we were aided in this as in all other matters by the cordial co-operation of the Director General, Mr. Goshorn, who secured the gradual relaxation or waiving of nearly all these rules, the enforcement of which in their integrity would have indubitably prevented the opening of the Exhibition on the appointed day.

Removal of initial difficulties.

Sale of goods during Exhibition.

The installation having been completed, there arose the question as to sale of duplicate goods. The regulations issued by the Director General, and communicated to all exhibitors, forbad the sale of articles, unless manufactured in the buildings, during the period of the Exhibition. Some manufacturers, however, had so

* Some of the Exhibition Buildings were created bonded warehouses by Act of Congress.

many exhibits that their show cases were not sufficient to display them properly, and the removal of certain objects would really have improved the general appearance, whilst others, relying on the course pursued at previous Exhibitions, had brought over many duplicate articles for immediate sale. Reasons for.

The Director General, trusting to the discretion of Commissioners, Superintendents, and the Exhibitors themselves, allowed the sale and removal of certain goods, but there were great objections to this on the part of the Customs authorities, chiefly owing to the schedules* not having been completed, and to the alleged difficulty of collecting duties on sales as they were effected. No obstruction was made to those who at once paid duties on their whole consignments, but this was of no benefit to our chief Exhibitors. To such an extent was the difficulty carried as regards non-completion of schedules that notices were issued threatening to seal up all show cases where this was not done within a certain date, and, as the schedules were required to be drawn up in a very minute manner, this became a serious matter. Difficulties attending.

The difficulty was however overcome; a special Joint Resolution of Congress being passed at the instance of the Secretary for the Treasury to facilitate these sales; arrangements were also made for the payment of Custom duties at the Exhibition, instead of at the City Custom House several miles distant, and consideration was shown to those the preparation of whose schedules required time and care. Eventually permitted.

The crisis in the working of the Department under notice came, however, at the close of the Exhibition, when regulations were issued of such a minute and searching character as, if carried out, would have detained our Exhibitors for months in Philadelphia. Final difficulties.

The British Honorary Commissioners and the Press here came to the aid of the Director General; and the Secretary of the Treasury at Washington took such an active part in smoothing matters as to remove all difficulties, except the delays consequent on a small Custom House staff having to perform almost overwhelming† labours, labours that occasionally involved the department's working throughout the whole night. Their removal. Labours of Custom House Authorities.

I have thought it necessary, in justice to the British staff and British Exhibitors, to report rather fully on this subject, but I should be sorry to give the impression of finding fault with individual officers who had novel duties to perform,—an International Exhibition in a country having a strictly protective tariff being rather an anomaly.

---

* A detailed and elaborate list of all articles exhibited, with their respective prices affixed.

† There were nearly 23,000 Foreign Exhibitors.

Appointment of Sir Edward Thornton as Special Commissioner.

XVII. Representation of Great Britain at opening and other ceremonies, including official Receptions to the Representatives of the United States and Foreign Countries. Appointment of three Honorary Commissioners.

Her Majesty's Secretary of State for Foreign Affairs, requested Her Majesty's Minister at Washington to represent Great Britain at the opening of the Exhibition.

Those desiring the success of the Exhibition were already deeply indebted to Sir Edward Thornton for the warm interest he had shown in the enterprise, both in England and in the United States, and his appointment was therefore hailed with the greatest satisfaction.

Opening of Exhibition.

The ceremonies at the opening of the Exhibition on the 10th of May were simple but impressive. Great distinction was shown to the British section; our National flag being on the immediate left of the position assigned to President Grant during the ceremonial, the American flag being on his right.

Official Hospitalities.

An entertainment was given that evening by Mr. George W. Childs, afterwards British Honorary Commissioner, at which the President of the United States, the Emperor of Brazil, and almost every person of distinction, American and foreign, then in the United States was present. Next evening a banquet was given by Sir Edward Thornton which President Grant, the Emperor of Brazil, and many American and foreign dignitaries attended.

Receptions at St. George's House.

St. George's House, the head-quarters of the British Commission, was honoured by visits from the President of the United States, the Emperor of Brazil, and all leading officials resident at or visitors to Philadelphia, also by many distinguished men in private positions in the United States, whose names are household words in England.

Appointment of British Honorary Commissioners.

Under these circumstances, to assist the Executive in representing this country properly, your Grace offered appointments as Honorary Commissioners to Mr. Charles E. K. Kortright, Her Majesty's Consul for the State of Pennsylvania, who in his official capacity had already been of great service to the Commission, and to Mr. Anthony J. Drexel and Mr. George W. Childs, two of the leading citizens of Philadelphia.

These gentlemen accepted the posts, and your Grace has acknowledged on several occasions the obligations we were under to the three British Honorary Commissioners for their support, and for the splendid hospitalities shown by them when acting in their representative character.

At the closing ceremonies Sir Edward Thornton again honoured us by heading our section, and his letter reporting the results of the Exhibition is recorded in the Department.

XVIII. System of Awards. Appointment of British Judges. Announcement of Awards. Special Appeals.

American regulations.

The American system of awards contained many new features, notably that the awards should in each case include written reports, signed by the Judges, giving the specific reasons for which the award was made.

The regulations were briefly as follows:

"Awards shall be based upon written reports attested by the signatures of their authors.

"Two hundred* Judges shall be appointed to make such reports, one half of whom shall be foreigners and one half citizens of the United States. They should be selected for their known qualifications and character, and must be experts in the departments to which they will be respectively assigned. The foreign members of this body will be appointed by the Commission of each country and in conformity with the distribution and allotment to each. The Judges from the United States will be appointed by the Centennial Commission.

"The sum of one thousand dollars will be paid to each commissioned Judge for personal expenses.

"Reports and awards shall be based upon merit. The elements of merit shall be held to include consideration relating to originality, invention, discovery, utility, quality, skill, workmanship, fitness for the purposes intended, adaptation to public wants, economy, and cost.

"Each report will be delivered to the Centennial Commission as soon as completed for final award and publication.

"Awards will be finally decreed by the United States Centennial Commission, in compliance with the Act of Congress, and will consist of a Diploma with a uniform Bronze Medal and a special report of the Judges on the subject of the award.

"Each exhibitor will have the right to reproduce and publish the report awarded to him, but the United States Centennial Commission reserves the right to publish and dispose of all reports in the manner it thinks best for public information, and also to embody and distribute the reports as records of the Exhibition."

Difference from regulations at previous Exhibitions.

The chief points of difference of these rules from those hitherto adopted were:—

1. A uniform instead of a graduated system of Medals and Diplomas.
2. Marking the different degrees of merit by the wording of the Judge's reports.
3. Committing the adjudication to a few Judges instead of to a number of jurors. At Paris (1867) the British section had 83, and at Vienna (1873) 50 jurors. At Philadelphia we had 25 Judges, including 4 for the Live Stock Exhibition.

---

* Afterwards increased to 250.

Appointment of British Judges.

It is obvious that the responsibility which this system threw upon the Judges was great, and in no respect at this Exhibition were we more fortunate than in the fact that your Grace secured the services of the eminent men who honoured the British section by their presence as Judges.

The names and reputation of these gentlemen were previously well known in the United States, and their appointment and willingness to act were taken as a great compliment.

The Centennial Commissioners had previously arranged to which groups the British Judges, who also represented our Colonies, should be allotted.

Groups and names of British Judges.

The following list embodies the names of our Judges with the groups for which they respectively acted:—

I. Minerals, Mining, and Metallurgy, including the Machinery. Isaac Lowthian Bell, Esq., M.P., F.R.S., C.E., late President of the Iron and Steel Institute; elected President of his Group of 21 Judges.

II. Pottery, Glass, Artificial Stone, &c. R. H. Soden Smith, Esq., M.A., Keeper of the National Art Library, South Kensington Museum; elected President of his Group of 10 Judges.

III. Chemistry and Pharmacy, including the apparatus. Dr. William Odling, F.R.S., Professor of Chemistry at the University of Oxford; elected Secretary of his Group of 10 Judges.

IV. Animal and Vegetable products, and the machinery for their preparation. (Included Wine and Spirits.) No British Judge, but Canada was represented by H. G. Joly, Esq., M.P. (Canada.)

V. Fish and Fish Products. Apparatus of Fishing. No British Judge.

VI. Timber, Worked Lumber, Parts of Buildings. No British Judge. Judge for Canada, the Hon. J. Skead.

VII. Furniture, Upholstery, Wooden Ware. No British Judge.

VIII. Cotton, Linen, and other Fabrics, including the materials and the machinery. Isaac Watts, Esq., late Secretary to the Manchester Cotton Supply Association; W. W. Hulse, Esq., C.E., of the Manchester Chamber of Commerce; Mr. Isaac Watts was elected President of this Group of 13 Judges.

IX. Wool and Silk Fabrics, including the materials and the machinery. Henry Mitchell, Esq., late Mayor of Bradford.

X. Clothing, Furs, India-rubber Goods, &c. No British Judge. Judge for Canada, M. P. Empey, Esq.

XI. Jewellery, Watches, Silver Ware, Bronze, &c. No British Judge.

XII. Leather, and Manufactures of Leather. No British Judge.

XIII. Paper, Stationery, Printing, and Book-making.—Machines and apparatus for type-setting, printing, stamping, embossing, &c. Sir Sydney H. Waterlow, Bart., M.P., one of the Aldermen of the City of London.

XIV. Apparatus of Heating, Lighting, &c. No British Judge.

XV. Builders' Hardware Tools, Cutlery, &c. The Hon. J. Bain, Lord Provost of Glasgow, and David MacHardy, Esq., J.P.

XVI. Military and Sporting Arms, Weapons, &c. Major Wm. H. Noble, R.A., late Associate Member of the Ordnance Select Committee and Second Officer of the Experimental Branch at Woolwich; elected Secretary of his Group of 6 Judges.

XVII. Carriages, Vehicles, and Accessories. No British Judge, but Mr. Dufus was appointed Judge for Canada.

XVIII. Railway Plant, Rolling Stock, Engines, &c. Captain Douglas Galton, C.B., late Royal Engineers, D.C.L., F.R.S.; elected President of his Group of 6 Judges.

XIX. Vessels, and Apparatus of Transportation. Colonel F. H. Rich, R.E., Inspector of Railways.

XX. Motors, Hydraulic and Pneumatic Apparatus. W. H. Barlow, Esq., C.E., Vice President of the Institution of Civil Engineers.

XXI. Machine Tools for Wood, Metal, and Stone. John Anderson, Esq., LL.D., C.E., late Superintendent of Machinery to the War Department; elected President of his Group of 9 Judges.

XXII. Machines and Apparatus used in Sewing, &c. Frederick A. Paget, Esq., C.E., Member of the Society of Civil Engineers of France, and Corresponding Member of the Society of German Engineers; elected Secretary of his Group of 4 Judges.

XXIII. Agricultural Machines, Implements of Agriculture, &c. John Coleman, Esq., of the Royal Agricultural Society of England; elected President of his Group of 7 Judges.

XXIV. Instruments of Medicine, Surgery, &c. No British Judge.

XXV. Instruments of Precision, Research, &c. Sir William Thomson, LL.D., D.C.L., F.R.S., Professor of Natural Philosophy at the University of Glasgow.

XXVI. Architecture and Engineering. Sir John Hawkshaw, C.E., F.R.S., late President of the Institution of Civil Engineers.

XXVII. Plastic and Graphic Art. Charles West Cope, Esq., R.A., Peter Graham, Esq., Vice President of the Society of Arts.

XXVIII. Education and Science. Sir Charles Reed, LL.D., Chairman of the London School Board; elected President of his Group of 8 Judges.

Live Stock Exhibition.

Horses.—T. Parrington, Esq., Helmsley Hall, Yorkshire.
Cattle.—Thos. Duckham, Esq., Barsham Court, Ross.
Sheep.—Owen C. Richards, Esq., Blandford, Dorset.
Swine.—G. W. Baker, Esq., Luton Hoo Park, Bedford.

Appointment of Chief of Bureau of Awards.

General Francis A. Walker was appointed by the Centennial Commission to be Chief of the Bureau of Awards. This was an appointment requiring the highest qualifications, and I am glad to express to your Grace, on the part of this Executive, the Judges, and the Exhibitors, the obligations we are under to General Walker for the manner in which he performed his onerous and delicate duties.

Difficulties anticipated from new rules.

Previous to the arrival of the Judges there had been considerable discussion among the Foreign Commissioners as to whether the novel rules would work with justice to their Exhibitors; but the example set by our own and other Foreign Judges of at once setting to work to carry out the rules put before them had the happiest effect. Moreover the sanction given by the Centennial Commission to the appointment by Foreign Commissions of special officers to assist in the proper representation of Exhibitors' claims before the different groups of Judges removed one of the greatest anticipated difficulties.

Appointment of British Delegate for Judges.

Mr. Arthur Trendell, Secretary to the Commissioners, was, with your Grace's sanction, appointed British Delegate for the performance of this important duty, a duty which Mr. Trendell carried out most efficiently, and greatly to the satisfaction of both Judges and Exhibitors. Mr. Trendell also acted in some degree as Official Delegate for Canada, and his services were warmly recognised by the Commissioners for the Dominion.

Installation of Judges.

The installation of the Judges on the 24th May was carried out in a very impressive manner by the Centennial Commission in the Judges' Pavilion, a large building specially erected for the purpose which its name indicated.

Severe labours.

The "heated term," one of the most severe ever experienced in America, was just then commencing, but our Judges set an example of devoted attention to duties requiring great and constant labours, both physical and mental, which called forth the openly expressed admiration of the American Authorities.

The following Table shows the number of British Exhibitors and of awards made to them:

Result of Judges' work as regards British Exhibitors.

Location.	Number of Exhibitors.	Number of Awards.
Industrial Hall, including Shoe and Leather Building.	409	359
Machinery Hall - -	104	83
Agricultural Hall - -	82	61
Horticultural Hall - -	5	5
Carriage Building - -	10	8
Photographic Building - -	14	9
Number of living Artists represented:		
Sculpture - -	9	2
Oil Paintings - -	97	24
Water Colours - -	36	6
Engravings - -	29	12
Architectural Designs - -	14	5
Live Stock - - -	16	13
Total - - -	825	587

There were also 854 awards made to India, Canada, and the British Colonies, making an aggregate of 1,441 to the British Empire, the grand total of Awards being about 16,000.

Names of successful Exhibitors.

The names of our successful Exhibitors are given in Vol. III., which also contains copies of the judges' awards in each case.

Awards by the British Judges in special competition among Canadian Exhibitors.

The Commissioners for the Dominion of Canada having been authorised to distribute a certain number of gold, silver, and bronze medals among their Exhibitors at Philadelphia applied to this Executive for the services of the British Judges to adjudicate on the claims thereto. Our Judges kindly consented to add this to their other labours, and while inspecting the Canadian Exhibits for the purpose of deciding on claims for the Exhibition awards, made notes on the comparative merits of the same with reference to this local competition. The result was the adjudication of 12 gold, 136 silver, 193 bronze medals, and 5 honourable mentions in 16 classes and in the Live Stock Department.

Reports by British Judges on their Groups.

I have great pleasure in submitting the very valuable reports on their respective groups which the British Judges have been so good as to prepare, reports which will be found most interesting not only to specialists but to general readers, as showing in particular the present condition of art and manufacture in the United States, and also amongst those nations which were represented at the Exhibition.

Announcement of Awards.

The Judges having completed their duties the Centennial Commission revised the reports, and announced with considerable ceremony the number of awards granted to each competing nation.

At the large and distinguished assemblage held for the purpose in the Judges' Hall on the 27th September were collected representatives from almost every part of the United States, and occasion was taken to manifest in such a marked manner the pleasure felt by the American nation at the part taken in the Exhibition by Great Britain and her Colonies as to justify special notice here.

I will copy the words of an American gentleman who thus described the scene of which he was a witness.*

"Beginning with the Argentine Confederation, the list of nations was called, and as the representative of each stepped forward to receive the roll for his country the audience took advantage of the occasion to give complimentary applause. This was very hearty indeed in honour of Brazil, Japan, Russia, France, Austria, and Germany. The great scene of the evening, however, was when the British Commissioner was called forward to receive the roll for the United Kingdom of Great Britain and Ireland.

"There was a roar of applause, followed by shout after shout, the entire audience rising to their feet in honour of the nation. The effect was electric, and after the Commissioner, bowing his acknowledgments, had retired, the audience took up the theme again, and with a second demonstration as hearty as the first called him out a second time. It was some minutes before the audience became sufficiently quiet for the ceremony to proceed, and then when the roll of the British Colonies was called, each Commissioner was received with warmth, the special compliment being given of calling each British Colony separately, an honour not done in the case of any other country."

Appeals.

The only appeals allowed were in the case of its being proved that an exhibit had been, from any accident, not fully inspected by the Judges of its group. Several British exhibits were in this category, and on the circumstances being represented additional awards were made in some instances.

Distribution of Awards.

I was enabled by the courtesy of the Director General to bring to England in December a considerable number of the Diplomas and of manuscript copies of the Judges Reports relating to each award, and most of the others were brought over in January, and at once distributed.

The Diplomas and Medals have since then been received, and their distribution effected at a very early date after the close of the Exhibition.

By Government.

XIX. Special Exhibits. Mention has already been made of the Collection sent by order of Her Majesty's Secretary of State for India, and of the presentation of a portion of this Collection to institutions in the United States.

* London "Times" correspondent.

The British Fine Art Collection, as has been also stated, was displayed chiefly at the public expense, as sanctioned by Her Majesty's Government.

There were also exhibited:— *The Science and Art Department.*

1. By the South Kensington Museum, by order of the Lords of the Committee of Council on Education, a collection embracing—
   - Drawings, photographs, etchings, medals, &c., illustrating the system and result of instruction given to students in schools of art throughout the United Kingdom.
   - Reproductions of works of art in the museum, as distinct from copies by students of schools of art.
   - Designs and photographs relating to the construction and decoration of the museum building.
   - Cases containing illustrations of economic entomology and diagrams prepared for and issued by the Science and Art Department for the use of schools of science throughout the United Kingdom.

Gift to Pennsylvania and Washington Museums. The greater portion of the works embraced in the first three classes was presented by your Grace's order to the Trustees for the Pennsylvania Museum; and the entomological collection and diagrams to the new Government Education Museum at Washington.

These gifts coming from an institution which bears such high repute in the United States were received with very great satisfaction, and the collection presented to the Pennsylvania Art and Industrial Museum was especially valued by the promoters of an institution who are taking the South Kensington Museum for their model.

2. A series of maps and portfolios was exhibited by the Ordnance Survey Office showing specimens of the work executed by this department. This collection, which excited great attention, was allowed to be presented by this Commission to the Pennsylvania Museum. *The Ordnance Survey Office. Given to Pennsylvania Museum.*
3. A selection of maps and sections by the Geological Survey Department of the United Kingdom, presented at the instance of the Director General by order of your Grace to the United States Geological Survey of the Territories at Washington. Professor Hayden, the distinguished head of this department, has shown his appreciation of the gift by sending a series of valuable reports, models, and beautiful photographs to the South Kensington Museum. *The Geological Survey of the United Kingdom. Presented to the United States Geological Survey Department.*

Women's Pavilion. The exhibition of women's work in a Pavilion erected from funds collected by a Ladies' Committee, and under their management, was one of the novelties of the Exhibition, and to judge from the uniformly crowded state of the building, the experiment was most successful. In this as in other departments, I must

confine myself to matters relating to our own section; but the enterprise and public spirit of the Ladies' Committee, headed by their able and zealous President, Mrs. E. D. Gillespie, will, I doubt not, be done full justice to in the Report of the Centennial Commission.

Assistance rendered by the Queen and Royal Family; by the Royal School of Art Needlework; and by Ladies of England.

The kind notice taken of this department by Her Majesty the Queen, in lending various works by Her Majesty and the Royal Family, was greatly valued in America, immense interest being taken in viewing these works; the sympathy shown by the 29 other exhibitors* who sent works of art and industry from England in furtherance of their American sisters' undertaking was also much appreciated. The Royal School of Art Needlework also exhibited some beautiful specimens in this Pavilion as well as in the Industrial Building.

Group of America.

A full-sized reproduction in terra cotta of the colossal group representing America, one of the corner pieces at the base of the Albert Memorial in Hyde Park, was manufactured and exhibited by Messrs. Henry Doulton and Co. This work excited great attention, and held the place of honour in the Memorial Building, the centre of the hall being allotted to the group. The Centennial Commissioners have acknowledged their obligations to the sculptor, Mr. John Bell, who specially superintended the reproduction. The work is now at the Government Museum, Washington.

XX. Close of the Exhibition. The closing ceremonies took place, as originally intended, on the 10th November. There was no diminution in the crowds of visitors up to the end,† but the Authorities resisted the natural temptation to keep the Exhibition open a few days longer, and indeed it would have been difficult to have carried out any such arrangement in the case of the British Section, with due regard to the return of our Exhibitors, and the unsold portion of their goods, before the usual severe winter weather set in.

Ceremonies conducted in the Judges' Hall.

Owing to the day being rainy, the ceremonies, instead of being conducted, as intended, in the open air, took place in the Judges' Hall, before the President of the United States and his Cabinet, Foreign Legations, and a large assembly of other officials. The Guard of Honour was provided on this as on other state occasions by the First Troop of Philadelphia City Cavalry, a corps which was raised 102 years ago, which formed General Washington's Body Guard in the Revolutionary War, and which has maintained its organisation and full numbers since its formation.

Guard of Honour.

First Troop of Philadelphia City Cavalry.

Sir Edward Thornton's letter describing these ceremonies and an official banquet given on the previous evening by the Centennial Commissioners is before your Grace.

---

* *Vide* page lxxv.

† No. of admissions on 8th November, 103,127.
„ 9th „ 193,078.
„ 10th „ 121,721 (wet day).

Immediately after the close of the Exhibition the work of dismantling, packing, and despatch was pushed forward with the greatest vigour, as already noticed in several parts of this Report, every exertion being made to secure the early return of our Exhibitors and of their goods.

Return of Exhibitors and their goods.

The withdrawal of the British Executive took place gradually, the Head Quarters leaving in December by the American steamship "Ohio." Our embarkation was honoured by the presence of many friends, official and private, and the happy results of the part taken by our countrymen at this International gathering might be clearly judged by the increase, if that were possible, in the cordiality shown to us during the closing days of our most agreeable sojourn in Philadelphia.

Departure of the British Staff.

XXI. Finance and Secretariat.

Before I refer to the administration of the Vote granted by Parliament for carrying out the duties entrusted to this Executive, I wish to bring to notice the disbursements made by the British Exhibitors, on account of expenses, a large part of which, as I have already mentioned, is often borne by the public treasuries in other countries on behalf of their Exhibitors.

Finance.

Of our Exhibitors 592 have been good enough to favour me with statistics from which I have been able to prepare the following Table:

Expenses incurred by British Exhibitors.

Invoice Value of Goods Exhibited.	Cost of Packing Cases, Show Cases, and Fittings.	Carriage and Freight of Goods.	Expenses attending Representation, including Fares to and from the United States, and Personal or Agent's Expenses.	Other expenses.	Total.
£	£	£	£	£	£
223,079	36,800	14,702	51,348	10,945	336,874

Making a moderate estimate of the sums which will probably be returned by those firms who have not yet been able to comply with my request for information on this subject, I may safely state that the invoice value of the manufactures and productions exhibited in the British Section, not including the Fine Arts Exhibition, was at least 250,000*l.*, and that the expenses incurred by our exhibitors in connection with the representation cannot have been less than 120,000*l.*

It was originally estimated that the expenditure of the Executive would be 50,000*l.*, and the grants by Parliament for the years 1875–76 and 1876–77 amounted to 48,500*l.*

Amount of Votes, 1875–76 and 1876–77.

The Table which follows this Report shows that the expenditure, up to the close of the Commission, amounts to 39,981*l.* 2*s.* 8*d.*, leaving a saving on the Votes for the two years of 8,518*l.* 17*s.* 4*d.*

Disbursements by British Treasury.

D 2

Enumeration of heads of services under which savings have been effected, and reasons for diminished expenditure.

It will be seen that the heads of service under which the expenditure has chiefly fallen short of the estimates are,—

1. Salaries, Wages, and Subsistence Allowances.
2. Expenses of Machinery in Motion.
2. Telegrams and Postage.

Salaries, wages, and subsistence allowances. Saving of 4,766*l.*

The reduction effected under the first head is due partly to the zeal with which the staff worked, thereby not only enabling the Commissioners to dispense with the services of additional officers for whose, remuneration funds had been provided, but obviating the necessity of filling up several casualties which took place from death and sickness. A considerable portion of the saving is also to be attributed to the effective manner in which the American Executive Authorities carried out their undertaking to instal the Exhibitors goods free of expense, as mentioned in the fourth paragraph of this report.

Expenses of machinery in motion. Expenditure 2,265*l.* less than anticipated.

The chief reasons for the expenses attending machinery in motion being less than estimated are, that, owing to the depressed condition of trade, several intending Exhibitors withdrew their applications for space after the estimates had been submitted, and that we received a much larger amount of assistance from the American Executive in this department than the experience of former Exhibitions had led us to expect.

Telegrams and postage, 1,130*l.* saving on estimate.

To the liberality of the Anglo-American Telegraph Company are we mainly indebted for the small expenditure under the head of Telegrams, this Company having during the last two years conveyed our telegrams free of expense. The benefits derived by the British Section from this concession have been very great, and Her Majesty's Government have recognised the obligation by presenting a testimonial, prepared by Messrs. Elkington and Co., to the Board of Directors.

Heads of service under which the expenditure has exceeded the grant.

Offices and Quarters, excess 926*l.*

The excess under the head of Offices and Quarters arises from the presentation of St. George's House, alluded to in Para. XI. The sale of this house would have brought the net expenditure well within the amount voted. But that expenditure would have been considerably greater had it not been for the courtesy of Mr. Lot M. Morrell, the Secretary of the Treasury, who put the British Commission on the footing of a Legation, and thereby relieved us from the payment of some 800*l.* customs.

This concession was granted shortly before our departure from America, and at an interview I had on the subject with the Secretary at Washington, Mr. Morrell was good enough to accompany the announcement of the decision of his department with very gratifying expressions of the pleasure which had been derived by the Government and people of the United States from the part taken in the Exhibition by this country.

Incidental expenses, excess 854*l.*

The item Incidental Expenses is one always difficult to estimate for, especially in a case like the present.

Labours of Financial Clerk.

The voluminous accounts connected with these disbursements, complicated by our having to work with both English and American currency at constantly varying rates of exchange, have been admirably kept by Mr. Hodgkinson, the financial clerk, who

has also, under similar difficulties, ably assisted me in keeping the books connected with the expenses incurred by us on account of the Indian, Queensland, Mauritius, Gold Coast, and Trinidad Governments.

Secretariat.

The Secretariat duties of this office have been very heavy; the number of letters received during the two years ending 31st March 1877 in London and in Philadelphia amounting to 23,082, the number of letters written being 16,269, besides the despatch of a very much larger number of printed and lithographed circulars.

No. of letters received and issued.

Small staff employed under supervision of the Secretary.

The number of clerks employed in both offices at one time never even during the heaviest press of work exceeded ten, and such an amount of correspondence could not have been carried on in the methodical manner which has enabled us to work with so few assistants had it not been for the able and experienced supervision of Mr. Trendell, who, as mentioned in para. III., has been in charge of the correspondence and accounts.

Conclusion.

More allusion would have been made in this report to the general details of the Exhibition were it not that a full report with all particulars will soon be published by the United States Centennial Commission. I have availed myself, therefore, of the statistics which the kindness of the Director General, Mr. Alfred T. Goshorn, has put at my disposal, only where these appear to elucidate any statements regarding the working of the British section.

Report by the Centennial Commission.

Labours of Staff.

I cannot conclude this report without again expressing my deep sense of the very valuable services which have been rendered in conducting the affairs of our various departments by Mr. Trendell, the Secretary to the Commissioners, by the Superintendents Mr. T. A. Wright, Dr. Anderson, Mr. J. M. Jopling, Mr. B. T. Brandreth Gibbs, by Mr. J. H. Cundall, Assistant General Superintendent, and by the other members of the staff who have, one and all, worked so hard during the last two years towards ensuring the success of the British Executive Commission.

I am well aware that the zealous labours of my experienced colleagues have been prompted by higher than personal motives, but it would be ungrateful of me not to record how much I am personally indebted to the limited staff with whom it has been my good fortune to be associated, for the assistance they have always so cheerfully given in carrying out your Grace's directions.

I have the honour to be,
My Lord Duke,
Your Grace's most obedient servant,
H. B. Sandford, Colonel,
Executive Commissioner.

The Duke of Richmond and Gordon, K.G.,
Lord President of the Council.

STATEMENT

OF

EXPENDITURE.

STATEMENT OF

Showing Sums granted by Parliament in the Years Exhibition of 1876 at Philadelphia, with Disburse-

Heads of Service.	Apportion-ment of Vote.
	£
Salaries and Wages - - - - -	14,250
Travelling Expenses - - - - - - -	4,000
Subsistence Allowances - - - -	5,500
Jury - - - - - - - -	2,500
Offices and Quarters in Exhibition Grounds -	8,000
Rent - - - - - - -	450
Fine Arts - - - - - - -	5,000
Expenses of Machinery in motion - -	4,000
Carriage of Materials - - - - - -	1,750
Telegrams and Postage - - - -	1,500
Special Printing and Labelling in America -	750
Incidental Expenses - - - - - -	800
£	48,500
	Saving on

EXPENDITURE.

1875–6 and 1876–7 for the Purposes of the International ments under the various Heads of Service.

Payments.			Saving.			Excess.		
£	s.	d.	£	s.	d.	£	s.	d.
11,794	7	8	2,455	12	4	—		
3,120	0	9	879	19	3	—		
3,189	5	6	2,310	14	6	—		
2,200	0	0	300	0	0	—		
8,926	8	5	—			926	8	5
462	4	9	—			12	4	9
4,815	12	1	184	7	11	—		
1,734	2	0	2,265	18	0	—		
1,479	0	10	270	19	2	—		
369	12	11	1,130	7	1	—		
235	8	10	514	11	2	—		
1,654	18	11	—			854	18	11
39,981	2	8	10,312	9	5	1,793	12	1
2 Years Vote - -			8,518	17	4			

MY LORD DUKE, Edinburgh, December 1876.

(1.) I HAVE the honour, as one of the Executive Commissioners appointed by your Grace to carry out the general arrangements of the British section of the Centennial Exhibition, held in Philadelphia this year (1876), to place before you an outline of the plans by which the space allotted to Great Britain and her colonies was distributed to the exhibitors.

(2.) In no previous Exhibition out of the United Kingdom has the amount of space required to meet the demands of intending exhibitors been nearly so great as upon this occasion; in the Paris Exhibition of 1867, the allotment by the Imperial Commission was only 70,000 square feet of horizontal space—in the Exhibition just closed our country and the colonies occupied nearly 200,000 square feet.

(3.) The planning out of this vast space required much judgment and great care, for the interests of the exhibitors are much involved in their being satisfactorily placed. This part of the work had been carried on for some time before I had the honour of joining the Commission, and was very nearly completed. As far as it was possible to foresee, every care had been taken, and the whole plans for installation were satisfactorily arranged by the Superintendent of Industrial Space, Mr. T. A. Wright, whose ample experience in previous Exhibitions, admirably fitted him for the task. The actual disposition of the space was much modified by circumstances occurring on the spot, most of which could not be foreseen in the preliminary arrangements in London. The actual distribution of space will be seen by the tables and plans in the Appendix to this Report.

(4.) One of the greatest difficulties in preparing plans for installation in the present case was the necessity, insisted upon by the Centennial Executive Commission, of adhering to their complex system of classification. It was faithfully carried out by us at great inconvenience, and much detriment to our general arrangements; but it was, as far as I could see, only observed by ourselves; other nations, not even excepting the Americans themselves, studied the advantages of position for their most attractive objects before the requirements of classification. Fortunately it happened that our chief exhibitors, especially the Messrs. Elkington; Daniell and Son; Barnard, Bishop, and Barnards; Doulton, Brown-Westhead, Moore, and Co.; The Watcombe Company; Cooper and Holt; Cox and Sons; Hardman and Co.; Howard and Sons; Jeffrey and Co.; Wright and Mansfield; Collinson and Lock; J. Schoolbred and Co.; Pim Brothers; and some others whose exhibits were of a highly decorative character, came to the front, and gave the best possible effect to the external lines of the British section.

(5.) In two special departments, namely, those of stained glass and carpets, the structural arrangements of the Exhibition building offered better facilities than have ever before been afforded on any similar occasion; and, consequently, the products of the

British carpet looms, and our stained glass windows, were seen to great advantage.

(6.) Beyond the allotment of the colonial space, in as fair proportions as could be decided upon, the arrangement of each colonial allotment was left entirely to the colonies themselves, and it was in every instance most satisfactorily done, and never have the colonies of Great Britain made a more important display. Two or three of the smaller colonies entrusted their exhibits and the arrangement of them to the British Commission.

(7.) The space in the Machinery Hall was well filled, and all the arrangements for the installation of the objects were exceeding well carried out by our superintendent of that department, Mr. J. H. Cundall, who superintended the fixing of the Galloway steam boilers, and the erection of the large machinery, his knowledge and indefatigable industry were of the greatest value in this and various other departments.

(8.) In the Agricultural Department the space actually occupied by Great Britain was very small indeed, smaller even than that of some of the colonies. This arose from the determination of our manufacturers of agricultural implements not to exhibit in America, owing to the prohibitive tariff on their manufactures. The food products, however, were numerous, and made a good display.

(9.) The Horticultural Department consisted of a large ornamental conservatory, with lean-to stoves on each side. In the interior the placing of the exhibited plants was very properly entirely under the direction of the Chief of the Bureau of Horticulture, who, however, was most obliging, and ready to comply with every wish we expressed in the interest of our exhibitors. Outside, the space was laid out in parterres, some of which were occupied by British exhibitors, notably by Messrs. Veitch and Sons, of Chelsea, whilst one of the most interesting features in the earlier period of the Exhibition was the grand display of rhododendrons, made by Mr. Anthony Waterer, of Knapp Hill, in a large framed tent similar to those now so familiar at the spring shows in London.

(10.) In the Department of Fine Art (Memorial Hall) the space allotted to Great Britain was all that could be desired; the lighting was perfect, and being for the most part from the roof, through lying-light ceilings, was so generally diffused that all parts were equally well lighted. This is a matter for great congratulation, because never has so large and fine a collection of British Art been exhibited out of our country, and it was to the people of the United States a pleasure of the highest order. The hanging of the pictures was carried out by Mr. J. M. Jopling in a very satisfactory manner.

I have the honour to be,
My Lord Duke,
Your Grace's obedient servant,
THOMAS C. ARCHER.

APPENDIX.

FLOOR SPACE in SQUARE FEET occupied by GREAT BRITAIN and her DEPENDENCIES within Main Building.

Great Britain and Ireland	54,155
Indian Empire	3,208
Dominion of Canada	24,118
Victoria	5,167
New South Wales	4,213
South Australia	1,536
Queensland	3,406
Tasmania	1,372
New Zealand	1,664
Ceylon, and Straits Settlements	22
Mauritius, and Seychelles Islands	212
Cape of Good Hope	645
Gold Coast	279
British Guiana	344
Bermudas	494
Jamaica	722
Bahamas	472
Trinidad	267
	102,296

In the CARRIAGE ANNEXE of Main Building.

Great Britain and Ireland	4,130
Dominion of Canada	1,015
New South Wales	63
	5,208

FLOOR and WALL SPACE in the FINE ART DIVISION, MEMORIAL HALL.

	Wall.	Floor.
Great Britain and Ireland	12,163	339
Dominion of Canada	3,296	77
	15,459	416

WALL SPACE in PHOTOGRAPHIC ANNEXE.

Great Britain and Ireland	660
Dominion of Canada	500
New South Wales	100
	1,260

FLOOR SPACE in MACHINERY HALL.

Great Britain and Ireland	33,298
Dominion of Canada	4,300
	37,598

Horticultural Hall and Grounds.

	Indoor.	Out.
Great Britain and Ireland - -	1,050	8,000
Victoria - - - - -	330	—
Jamaica - - - -	320	—
New Zealand - - - -	50	—
Bermuda - - - -	50	—
	1,800	8,000

Floor Space in Agricultural Hall.

Great Britain and Ireland and Colonies - -	12,224
Dominion of Canada - - -	10,387
	22,611

Total of Space in Square Feet.

Main Building - - - - -	102,029
Carriage Annexe - - - -	5,208
Memorial Hall - - - - -	15,875
Photographic Annexe - - -	1,260
Machinery Hall - - - - -	37,598
Horticultural Hall - - - -	9,800
Agricultural Hall - - - - -	22,611
	194,381

Total of occupied space in, and belonging to, the above-named Exhibition Buildings, 1,352,627 square feet.

It will thus be seen that Great Britain and her Dependencies occupied a seventh part of this vast space.

BRITISH SECTION OF THE PHILADELPHIA INTERNATIONAL EXHIBITION OF 1876.

UNDER THE DIRECTION OF THE LORDS OF THE COMMITTEE OF PRIVY COUNCIL ON EDUCATION.

His Grace the DUKE OF RICHMOND AND GORDON, K.G.,
Lord President of the Council.

The Right Hon. the EARL OF BEACONSFIELD, First Lord of the Treasury, and Lord Privy Seal.
The Most Hon. the MARQUESS OF SALISBURY, Secretary of State for India.
The Right Hon. RICHARD ASSHETON CROSS, M.P., Secretary of State for the Home Department.
The Right Hon. GATHORNE HARDY, M.P., Secretary of State for War.
The Right Hon. SIR STAFFORD H. NORTHCOTE, Bart., M.P., Chancellor of the Exchequer.
The Right Hon. GEORGE WARD HUNT, M.P., First Lord of the Admiralty.
The Right Hon. GEORGE SCLATER BOOTH, M.P., President of the Local Government Board, and
The Right Hon. VISCOUNT SANDON, M.P., Vice-President of the Committee of Privy Council on Education.

OFFICES.

London - - -	5, Craig's Court, Charing Cross.
Philadelphia - -	St. George's House, Fairmount Park.

Special Commissioner to represent Great Britain at the opening and other Ceremonials.

The Right Hon. SIR EDWARD THORNTON, K.C.B., Her Majesty's Envoy Extraordinary and Minister Plenipotentiary at Washington.

Honorary Commissioners.

CHARLES E. K. KORTRIGHT, Esq., Her Majesty's Consul for Pennsylvania - -	Philadelphia.
ANTHONY J. DREXEL, Esq. - - -	Philadelphia.
GEORGE W. CHILDS, Esq. - - -	Philadelphia.

JOINT EXECUTIVE COMMISSIONERS.

Colonel Sir HERBERT B. SANDFORD, R.A.
Professor THOMAS C. ARCHER, F.R.S.E.

A. J. R. TRENDELL, Esq., Secretary; Official Delegate to the British Judges.

Staff.

Superintendent, Industrial Space -	Thomas A. Wright, Esq.
Superintendent, General Machinery -	John Anderson, Esq., LL.D.
Superintendent, Fine Arts - -	J. Middleton Jopling, Esq.
Superintendent, Agriculture and Horticulture - - -	B. T. Brandreth Gibbs, Esq.
Assistant General Superintendent and Engineer - - - -	Joseph H. Cundall, Esq., C.E.
Assistant Superintendent, Catalogue and Official Publications - -	Hugh Willoughby Sweny, Esq.
Financial Clerk - - -	Frederick J. Hodgkinson, Esq.
Assistant for Machinery - -	Ernest E. Cooper, Esq. Died June 1st, 1876.
Clerk for Correspondence - -	Ernest Charrington, Esq.
Clerk for Passenger and Transport Arrangements - - - -	Henry A. P. Rooke, Esq.
Registrar and Custodian of Official Papers - - - -	Mr. Lewis A. Rittman.
Clerical Assistant - - - -	Mr. B. Baggett.*
Ditto - - - - -	Mr. J. W. Smith.
Ditto - - - -	Mr. W. J Lloyd.
Ditto - - - -	Mr. F. M. Bryant.
Ditto - - - - -	Mr. H. F. Corby.
Ditto (For Custom House and Shipping) - - -	Mr. E. R. Huckel.
Messenger and Copyist - - -	Samuel Alford.
Office Keeper - - - -	Frederick Nicholls.

Royal Engineers.

Sergeant J. Wright.
Corporal J. Snelling.
Corporal E. Whitehead.
Sapper W. Crighton (Queensland).

Metropolitan Police.

Active Force.

Inspector C. Hagen.
Sergeant P. H. Giles.
Sergeant A. Winkler.

Pensioners.

Chief Inspector Wm. G. Howland.
Sergeant Thomas Joseph Firman.†
Sergeant Wm. Hy. McNamara.
Sergeant Thomas Rowe.
Constables–Samuel Doble.
William House.
Alfred Lyons.
Henry Roots.

* Died April 16th, 1877. † Died September 26th, 1876.

INDIA.

J. Forbes Watson, Esq., M.D., Reporter on Products of India.
J. M. Brett, Esq., Assistant in Charge.
Corporal J. Owen, Royal Engineers.
Inspector Henry Beckerson. } Metropolitan Police (Pensioners).
George Henry Blake. }

For the Resident and other Colonial Commissioners, see Lists in Volume II., prefixed to the Report from each Colony.

Fine Art Committee.

Sir Francis Grant, P.R.A.
Sir John Gilbert, R.A., President of the Society of Painters in Water Colours.
Henry W. F. Bolckow, Esq., M.P.
Frederick W. Burton, Esq., Director, National Gallery.
P. H. Calderon, R.A., Esq.
Alfred Clint, Esq., President of the Society of British Artists.
Henry W. Eaton, Esq., M.P.
George Fox, Esq.
Albert Grant, Esq.
Louis Haghe, Esq., President of the Institute of Painters in Water Colours.
Holman Hunt, Esq.
Frederick Leighton, Esq., R.A.
Thomas Lucas, Esq.
W. Calder Marshall, Esq., R.A.
John E. Millais, Esq., R.A.
Val. Prinsep, Esq.
Richard Redgrave, Esq., R.A.
William Smith, Esq., F.S.A.

J. Middleton Jopling, Secretary.

Mr. INSPECTOR HAGEN.

POLICE AND SANITARY ARRANGEMENTS.

Memorandum on the Police and Sanitary Arrangements at the Philadelphia International Exhibition, 1876. By Mr. Inspector Hagen of the Metropolitan Police.

Sir,

I respectfully beg to submit herewith my report on the Services of the Police at the Philadelphia Centennial Exhibition of 1876, with memoranda on various other matters which came under my observation.

Arrival in Philadelphia.

Having left London on the 9th of February 1876, I arrived at Philadelphia on the 29th in the S.S. "Lord Clive," being joined on the following day by Serjeants Winckler and Giles, and 10 pensioned officers of the Metropolitan Police, who had been recommended by their former superintendents, and approved of by Colonel Henderson, on account of their good conduct and trustworthiness while in the service.

Boarded and lodged in the British cottages.

All of us were lodged free and boarded at a reasonable rate, together with a party of Royal Engineers, some junior members of the staff, and a number of English mechanics and labourers, in the two cottages erected for our accommodation by the British Commission in the Exhibition grounds, adjacent to St. George's House, the head quarters of the Commission.

Discipline.

The discipline and cleanliness in the cottages, except as to the Royal Engineers, who were under the control of Sergeant Wright, were placed under my charge; for the guidance of the inmates, a set of regulations were issued which, carried out with discretion as strictly as the peculiar circumstances surrounding us would permit and enforced when necessary with firmness, by the Executive Commissioner, enabled us to preserve the necessary order and comfort.

Sanitary arrangements.

The sanitary arrangements in the cottages were a source of the greatest anxiety to the Commission, and from the first were carefully looked to; closets and sinks were daily disinfected, proper ventilation was provided, water efficiently filtered, and the utmost cleanliness exacted; supervision by the Commission was searching and constant, and the consequence was the health of the inmates was all that could be reasonably expected; no illness occurred during the first four months of our stay, and when in July the heated term commenced (extraordinary even for Philadelphia), lasting nearly all through August, the benefit of our attention to health and cleanliness became apparent. Typhoid fever and malaria became institutions around us, and cases of sunstroke were alarmingly frequent, but the British Colony, although not altogether escaping attack, lost none of its numbers by these causes. In connection with this subject it becomes a pleasing duty to acknowledge with gratitude the eminent and valuable services of Dr. Herbert, the resident Physician of the Centennial Commission, who, with the most unsparing devotion to duty, was ever ready to attend any of us at any time, night or day, when called upon, and whose kind attention will be remembered by all of us with gratitude.

Health of the inmates.

Epidemics.

Medical assistance.

Comparative Table of Health in buildings within the ground.

The subjoined table will convey an idea of the healthiness of the British cottages as compared with the surrounding establishments in the grounds of the Exhibition, where altogether close upon 3,000 persons continually resided.

	Residents.	Cases. of Fever.	Deaths.
Barracks of Centennial Guards	700	65	11
Japanese Commission Staff	23	7	—
British Commission Staff	35	2	—
Lafayette Restaurant	60	10	2
French Restaurant	200	43	7
Lauber's Restaurant	140	35	6

Precautions against fire.

The whole of the buildings surrounding the British cottages were wooden erections, and in consequence of the frequency of fires and alarms of fire, the hose was attached every evening to the two hydrants in our grounds, the men were occasionally exercised in fire drill, all lights and fires were extinguished at midnight, and every precaution was taken against an ever present danger, from which, however, we fortunately escaped.

Visitors to cottages.

The cottages were visited during the Exhibition by large numbers of persons who evinced great interest in, and were greatly pleased both with the arrangements for the comfort of the inmates, including the cooking of our meals in English fashion, the furniture of the kitchen, and with the thoroughly English appearance of our homes, enhanced by the kitchen garden laid out, planted, and tended by the men.

St. George's House.

St. George's House placed under the charge of Sergeant Winckler and his wife, and used as offices by the Commissioners of Great Britain and her Colonies, was acknowledged to be one of the chief attractions of the Exhibition, and upwards of 11,000 persons, amongst them many visitors from England and foreign countries, the President, many governors, senators, and celebrities of the United States, with their wives and families, registered their names in the Visitors' Book, whilst the total number of visitors amounted to over 40,000.

Entertainments given by Commissioners.

Frequent entertainments were given to the élite of visitors and notabilities of Philadelphia by the Commission and Honorary Commissioners at St. George's House, on which occasions the men under my orders were employed in regulating the carriages, often numerous, preventing unauthorised intrusions, guarding against danger from fire, &c.

Duties of police.

The regular duties of the police commenced soon after our arrival, with the installation of the Exhibition.

Reception of goods.

The whole of the goods forwarded were unloaded and conveyed to their places in the different buildings by the employés of the Terminal Agency; the address and number of each package were checked by the police, and reported by me at the close of each day to the Executive Commissioner; damage to cases and contents being duly noticed.

Damage reported.

Unpacking goods.

When the unpacking of the goods had commenced the police were directed as an additional security to patrol the British sections during the daytime, and very few larcenies occurred during the installation. From the opening of the Exhibition on the 10th of May the guardians were posted as follows :—

Posting of guardians, and positions taken up.

Howe, Doble	Fine Art Galleries.
Beckerson, Blake	Indian Court.
Lyons, Rowe, Mac Namara, Roots	Main Buildings.
Howland	Machinery Hall.
Firman	Agricultural Hall.

Sergeant's duties.

In addition to this, Sergeant Giles patrolled the whole of the buildings under my directions.

The men were on duty from 8 a.m. until the close of the buildings, about 6.30 p.m., with an hour, and in the heated term two hours, for dinner.

Morning reports.

A morning report was daily submitted by me to the Executive Commissioner, detailing the duties of the police on the previous day, any occurrences with reference to the discipline in the cottages and other facts coming under police notice.

Death of guardian Firman.

On the 16th of August guardian Firman was taken ill, and had to be removed on the 20th to the University Hospital, Philadelphia, where, notwithstanding the best medical skill and attendance, he died on the 25th of September from the effects of a tumour on the chest.

Health of the men.

The remainder of the men bore the trying climate exceedingly well, were every day on duty, and at the end of the hot weather a week's leave of absence being granted to them, two at a time, by the Commissioner to visit the Falls of Niagara, for which trip they were kindly furnished with free passes by Colonel Scott, the President of the Pennsylvania Railway Company, they returned from their outing with renewed energy and strength for the severe work of the closing days of the Exhibition.

Leave of absence.

Value of police supervision.

Few larcenies during installation.

The value of police supervision of our own was apparent at a very early stage of the undertaking. During the unpacking of the goods, numerous petty larcenies occurred in all sections except the British, where they were comparatively few. The Imperial German Commission soon followed our example, and engaged a staff of guardians from German residents of Philadelphia,

while the French Commission found itself compelled after severe losses during the Exhibition to send for a number of officers from the Paris Municipal Police to protect the goods of their exhibition during the repacking.

Other Commissioners employ their own police.

Next to the security of the exhibits from robbery the attention of the guardians was specially directed to the prevention of sketching patented or other valuable objects; as a general rule such attempts were willingly relinquished on request, and only two instances occurred in the British section where the right of the public to take sketches was insisted upon. In one case an American exhibitor of pumping machinery was detected by guardian Howland in Machinery Hall taking a sketch and the dimensions of the pumps exhibited by Messrs. Gwynne; when requested by the guardian to desist he refused, and also declined to give up the paper on which he had sketched, asserting that he had a perfect right to do it, upon which the guardian took the paper from his hand by force, and removed him from the exhibit; for this a warrant was obtained against the guardian for assault and battery, and at the hearing the sitting magistrate decided that the law of the Commonwealth did not recognise the Exhibition regulations and the guardian was held in 300*l*. bail for trial.

Police also employed to prevent the taking of sketches.

Two instances in which the sketcher persisted,—action taken.

Guardian Howland held in 300*l*. for trial.

However, on the matter being brought to the notice of the General Director, steps were taken which induced the magistrate to alter his opinion, and to acknowledge his decision wrong. In the second case guardian Beckerson found an American watchmaker sketching the patented escapement of one of Frodsham's chronometers, he also refused to desist, and I had him taken to the office of the Director General, where the sketch was taken from him, and he was threatened with expulsion from the buildings if caught again in a similar attempt.

The magistrate alters his opinion.

The Guardians upheld by Director General.

The presence of English guardians in our section was soon known amongst the public, and the men were constantly applied to by visitors announcing themselves of English birth or extraction, for information respecting the exhibits or the place they were sent from and I am sure our services in this particular have been much appreciated.

Information asked of guardians.

Guardian Doble arrived on the 3rd of April in charge of the first consignment of paintings, by S.S. "Ohio," and Guardian Howe on the 18th April, with the rest of the pictures and statuary, in the S.S. "Indiana;" both men were on duty in the galleries during the unpacking and hanging of the pictures, and remained in charge of them during the Exhibition.

Arrival of pictures.

Of the 9,000,000 visitors to the Exhibition it may safely be said that by far the greater part visited the Memorial Hall and the British Galleries, where especially the painting of the marriage of the Prince of Wales was a universal attraction; the crowd in front of this picture was impassable from the opening to the closing of the doors, and it was necessary to have a guardian continually stationed there to protect the picture, and keep the crowd moving; the whole of our galleries were more crowded at any time than any other part of the buildings; umbrellas and sticks were allowed to be retained by visitors, and the pointing with those and with fans, carried by both sexes, constituted a constant danger to the paintings. It was indeed evident that the great majority of the visitors were entirely unused to visits to Art galleries, and seemed not to be able to appreciate the works unless allowed to touch the points they admired or criticised.

Visitors to Art galleries.

Crowds attracted to the painting of the Marriage of the Prince of Wales.

Danger to paintings, &c.

No means were provided by the authorities to regulate the crowd, and the people unused to the situation were often helplessly jammed. By posting up notices, "Keep to the right," in the British section, we effected, however, a great improvement, which was soon appreciated by the public, who seconded our efforts by repeating the words of the notice amongst themselves.

Helpless crowds in Art galleries. Notices put up.

The two guardians were effectually assisted by some of the most intelligent and active men of the Centennial Guard, and under all the trying circumstances it is highly satisfactory that their zeal and attention have been successful in preventing all damage to their valuable charge.

Centennial Guards aiding in care of paintings.

The security and care of the grounds and buildings, with their contents, were entrusted to the corps of Centennial Guards, organized by and under the command of Colonel Clay and Major Alberger, responsible to the General Director; a staff of janitors, responsible to the Board of Finance; a body of firemen under Captain Smith, who was also the agent for the Philadelphia Insurance Companies, responsible to the Board of Finance, and a force of

Care of buildings and grounds.

Centennial Guards.

Janitors.

Firemen.

U.S. Custom House Officers.

Number of Centennial Guards, 1,053.

Division into six companies.

United States Custom House Officers. The Centennial Guards, augmented from time to time during the first months of the Exhibition, until on the 1st of July they numbered 1,053, were reduced on the 1st of August to 700, at which strength they remained until the close, when further gradual reductions took place as circumstances permitted. The men were posted into six companies, each under a captain, to the same number of precincts; they were engaged for the term of the Exhibition, or so much of it as might be required, and the pay was $2 per day, whilst each month a week's pay was kept in hand to be forfeited in case of dismissal for misconduct.

Majority soldiers in U.S. or Confederate armies.

Admirable manner in which their duties were performed.

Orderly character of American crowds.

Few cases of drunkenness.

The majority of the men had been in the armies of the United States or the Confederacy during the War, but scarcely any of them had any knowledge of police duties, their organization and discipline were strictly military, and they were appointed upon the recommendation of politicians and prominent men without much reference as to character. It must, however, be admitted that the manner in which the men performed their arduous duties and preserved order amongst the unprecedented crowds visiting the Exhibition reflects the highest credit upon the officers who directed this heterogeneous body of men, entirely new and unused to the difficult task they had to perform. One fact, however, must be mentioned in connection with this, the absolute sobriety and orderly conduct of an American crowd; it will scarcely be credited by English readers, but it is a certain fact that during the whole of the Exhibition, with as many as 256,000 visitors in one day, scarcely a case of drunkenness was seen.

Residence of guards within the grounds.

The British police receives friendly assistance from the guards.

The whole of the guards were required to reside in the grounds, and were quartered in six barracks, one to each company; they were allowed leave one night in three, to visit their friends and families in town, but with this exception they were always on duty, either on post in the grounds or buildings in reliefs of four hours each, or on reserve at their barracks; from their commander and officers, as from the men, the British police at all times received the most friendly and kind assistance.

Prevention and extinction of fires.

The firemen, 200 strong, were posted to the different sections of the buildings, with a reserve force at their four different stations within the enclosure; the appliances and arrangements for the prevention and extinction of fires, and the acquaintance of the men with their work were little short of perfection, and it is undoubtedly owing to their high state of efficiency that the rather frequent occurrence of fires and alarms of fires were attended with no serious results to the Exhibition.

Duties of janitors.

The janitors, 240 in number, under the orders of the superintendents of the various buildings, and responsible to the Board of Finance, were employed in sweeping, cleaning, and attending to the numerous gaslights with which the buildings were lighted at night; in the commencement some of their number were also posted at each door in conjunction with Centennial Guards and Custom House Officers, but were withdrawn at an early date.

Stealing in excess of former exhibitions.

Remarkable scarcity of cases of pocket-picking.

A special detective force employed

With those numerous bodies of protectors the goods in the buildings should have been exceptionally safe, but it cannot be denied that losses by stealing have been greatly in excess of those at any former Exhibition, and the dissatisfaction of the exhibitors at this disagreeable fact was unsparingly expressed. Whether as was not unfrequently suggested the presence of five different bodies of men who could shift the responsibility from one to the other, instead of one force responsible to a single chief, had anything to do with this unsatisfactory state of things is a matter of opinion, but the remarkable fact exists that nearly all losses of property occurred during the night-time, and the outside thieves therefore, cannot be blamed. In remarkable contrast, however, with the insecurity of exhibits was the extreme scarcity of cases of pocket-picking in the Exhibition, even on the most crowded days as a special detective force was employed, composed of 30 of the principal detective officers from the chief cities in the Union, to each of whom were known all the noted pick-pockets of his town, the latter being also aware of the officers presence at the Exhibition.

To this happy arrangement, aided by the certainty of conviction for every thief seen within the grounds or approaches, must doubtless be ascribed the security of personal property in the Exhibition, while on tramcars and in the streets of the city larcenies from the person were frequent enough. Indeed, the contrast was so marked that I have heard it jestingly suggested, that the thieves had carte blanche from the police for the city on the understanding

that they were not to operate in the Exhibition, and a letter appeared in the "Philadelphia Times" asking the Mayor to allow the light-fingered fraternity a day to visit the show, on which occasion they on their part would solemnly undertake to divest their minds of all business cares.

The thieves ask permission to visit the show.

Visitors, exhibitors, staff, and workmen were admitted at each of 13 gates, in charge of a force of 120 gate and turnstile keepers, responsible to Mr. Yates, the chief of the Bureau of Admission, with whose office the whole of the turnstiles were connected by telegraph, so that from hour to hour the total number of admissions was known at head quarters.

Admission tickets.

Hourly registration of number of visitors.

The arrangements for the admission of ticket-holders was in agreeable contrast with our experience at Vienna, each ticket contained the holders' photograph, the dates of the 180 days of the Exhibition were printed consecutively in the margin, and at the holder's first entrance each day the respective date was punched by the stile-keeper, while on each subsequent entry on the same day a check obtained on leaving the grounds procured re-admission. These arrangements, whilst rendering fraud almost impossible, were, as regards convenience to the holders, perfect in their simplicity.

Contrast of admission arrangements with those at Vienna.

Checks given for re-admission.

Probably no part of the arrangements connected with the Exhibition caused greater dissatisfaction among British exhibitors than the Custom House formalities; the officials of that service have come in for a considerable amount of bad feeling; it must, however, be borne in mind that at first no special facilities had been granted by the legislature for Exhibition goods, and that the officers had to carry out the same regulations as applied to all merchandise sent to America in the regular course of trade, where a delay of a week or longer in the Custom House is often a matter of not so much consequence.

British exhibitors dissatisfied with the Custom House officials.

The evil effects of this absence of special facilities were augmented by the circumstance that the majority of the lower grade officials were men newly engaged who knew little or nothing of the business, and when it was found that in accordance with the law every package had to be opened on its arrival, and every article of its contents examined by the Custom House officers, it became necessary to have one of the guardians always present at the operation, to note if necessary any damage done to the goods by men who were quite unaccustomed to their handling. The earnest exertions of the Commissioner, however, soon brought about a change in the state of affairs, a special Act was passed by the Legislature, and the greater part of the difficulties passed away or were considerably smoothed over and at the breaking up of the Exhibition the Custom House arrangements worked easily and expeditiously.

Guardians present during the unpacking of British goods.

A special Act passed.

During the month of June I received directions from the Executive Commissioner to report on the condition of the empty packing cases, which had been taken charge of by the Terminal Agency, and were supposed to be stored on a piece of ground in the vicinity of the Exhibition; upon examination I found the cases in a deplorable state of confusion, those of all countries being thrown promiscuously together, and exposed to sun and rain. Upon my report, a plan was suggested to the General Direction by the Commissioner for the proper separation and storage of the cases, which plan was subsequently adopted and carried out by the contractors.

Condition of empty packing cases.

At the beginning of August the cases were stored in proper order and effectually sheltered, and no doubt would have been returned to exhibitors in proper time and condition had a fire not unfortunately occurred on the night of the 24th of August by which upwards of 1,400 British cases besides a considerably larger number belonging to other countries were destroyed. By the exertions of the fire brigade and the British staff we succeeded in saving the whole of the valuable cases of our Art collection, but the destruction of so many cases, all of them belonging to exhibitors in the Main Building, was the cause of considerable delay at the close of the Exhibition, when they had to be replaced as far as required by the exhibitors. Immediately after the close of the exhibitions the packing of the British Fine Art Collection was so energetically pushed forward that the last picture was safely packed on the 24th November, while on the 22nd the first consignment had left for England in the S.S. Indiana under the charge of Sergeant Giles and Guardian Howe, accompanied by Rowe and Blake. The remaining pictures were sent on the 29th November in S.S. Illinois in charge of Guardians Howland and Doble, all arriving safely in due course at the South Kensington Museum.

British and Foreign packing cases destroyed by fire.

Fire brigade and British staff.

Packing cases replaced by exhibitors.

Pictures repacked.

Arrival of pictures at South Kensington Museum.

The packing of goods in the various buildings proceeded so rapidly and satisfactorily that the Commission was able to dispense with my services and those of the remaining guardians on the 7th of December, at which date I sailed with Lyons, Mac Namara, and Roots in the S.S. Lord Clive, arriving in Liverpool on the 21st, while Guardian Beckerson left Philadelphia on the 14th, arriving on the 24th in the S.S. Ohio, thus closing the services of the officers and pensioners of the Metropolitan police under the Executive Commission, services I am happy to add performed in such a manner as to meet with the repeatedly expressed satisfaction of the Executive Commission and with favourable recognition from the exhibitors.

Disembarked at Liverpool.

Entire approbation expressed by the Executive Commission as to conduct and exertions of the officers and pensioners of the Metropolitan police.

30th January 1877.

CHARLES HAGEN,
Inspector, Metropolitan Police.

Colonel H. B. Sandford, R.A.,
Executive Commissioner.

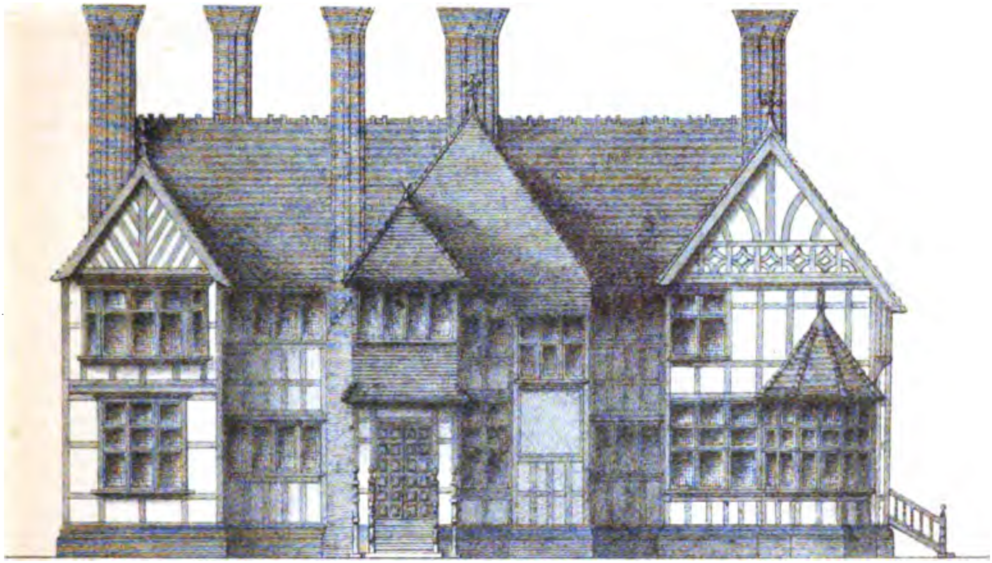
Exhibitors from Great Britain and Ireland in Women's Pavilion.

Her Majesty the Queen	Two table napkins spun by Her Majesty. Series of etchings by Her Majesty and one by Her Majesty and H.R.H. the late Prince Consort.
H.R.H. The Princess Louis of Hesse H.R.H. The Princess Christian of Schleswig Holstein	Embroidered table cloth.
H.R.H. The Princess Louise (Marchioness of Lorne).	Embroidered banner screen.
H.R.H. The Princess Beatrice	Water colour drawings. Flowers.

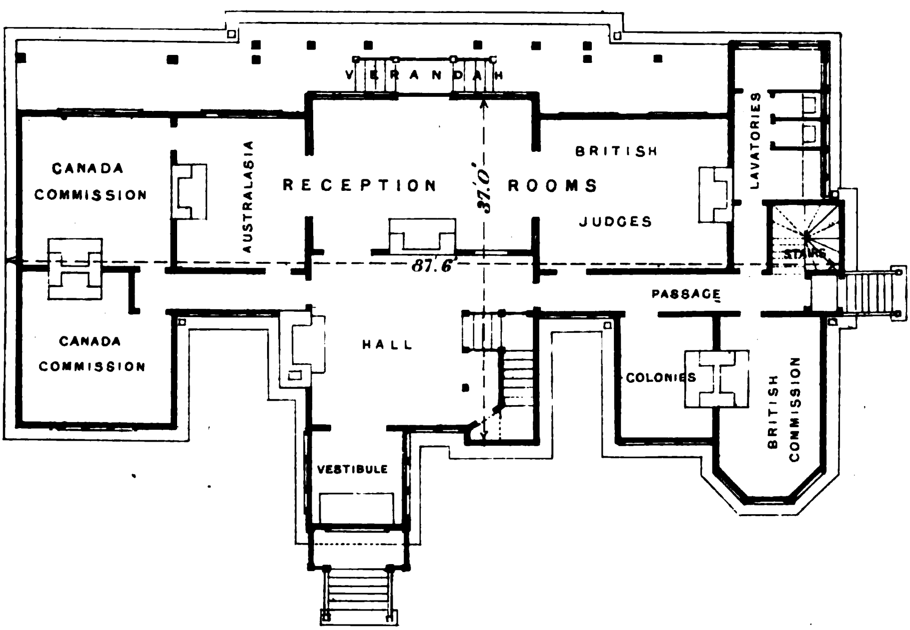
Carr, Miss F., The Firs, Lavender Hill, S.W.	Specimens of needlework.
Dunglison, Mrs., 47, Cumberland Street, Warwick Square.	Coloured Scrap Screen artistically designed, one leaf representing "Dream of H.R.H. the Prince of Wales after a day in the Jungle."
Frere, Miss C. F., Wressil Lodge, Wimbledon, Surrey.	White silk fan. Subject, Fête Champêtre à la Watteau, illustrating "The Five Senses," and two water colour drawings.
Harding, Miss Caroline, Harding, Miss Emily, Islington Lodge, King's Lynn, Norfolk.	Needlework. — Portière. — Conventional Sunflower, in crewels and silk on serge.—Panel for screen.—Subject: Owl. — Bed Quilt on Hopsack. Subject: Sunflowers.
Hubbard, Miss L., 24, Princes Gate, Hyde Park, and Addington Manor, Winslow, Buckinghamshire.	Flax thread pillow lace made by cottagers in Buckinghamshire.
Hudson, Mrs. A., Hudson, Miss E., Bank, Buckingham.	Point lace.
Paget, Miss Nina, No. 28, The Boltons, West Brompton, S.W.	Crewel embroidery.
Palmer, Miss H. M., 53, Lowndes Square, S.W.	Point lace; parasol cover.
Parker, Mrs. M. E., The Cliff, near Dundee.	Four lace shawls; four-leaved picture screen; embroidered tea cozéy; leather-work.
Preble, Miss Mary, National Galler Trafalgar Square.	Water colours; series of seven, illustrating Voyage of Columbus and Discovery of America, after Turner; Sunset at Gadshill, Home of Charles Dickens. Oil painting, "The Pet Spaniels," after Landseer.

Rooke, Mrs. H. A. P., Esher, Surrey -	Couvrette of Macramé lace.
Rooke, Miss E. E., Wymondley Vicarage, Stevenage, Herts.	Couvrette in Macramé lace and crimson satin. (This is a kind of Old English knotting, done without bobbins).
Salt, Miss S. A., 29, Gordon Square, W.C.	Oil painting, "Threatening Rain, Bournemouth Common."
Wilkinson, Miss G., 12, Douro Place, Kensington.	Water-colour drawings from nature—Nice and Cannes.
Hayes, Miss A., 13, Cathcart Road, West Brompton.	Crewel embroidery.
Johnson, Miss, Elgin Lodge, Melton Mowbray.	Crewel embroidery.
Mason, Mrs., Elgin Lodge, Melton Mowbray.	Embroidery in silks.
Maude, Miss, Tregunter Road, Boltons, West Brompton.	Crewel embroidery.
Noel, Mrs., née Baronne von Henniger, 10, Neville Street, Onslow Square.	Crewel embroidery.
Hockdale, Miss, } Nicholson, Miss, } Moreton Vicarage, Bourne, Lincolnshire.	Embroidery on serge.
Worsley, Miss, 14, Gilston Road, West Brompton.	Crewel embroidery.

ST GEORGE'S HOUSE.



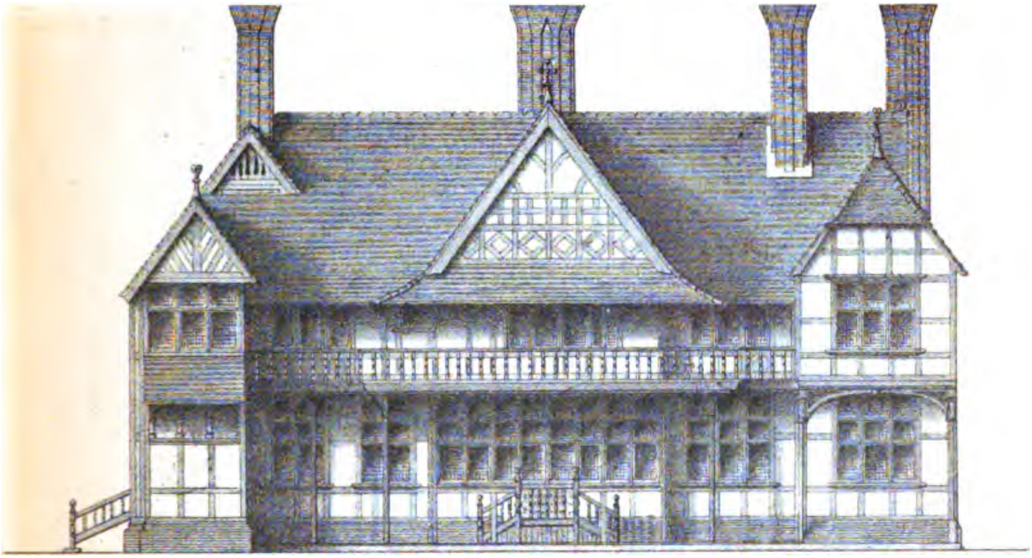
FRONT ELEVATION.



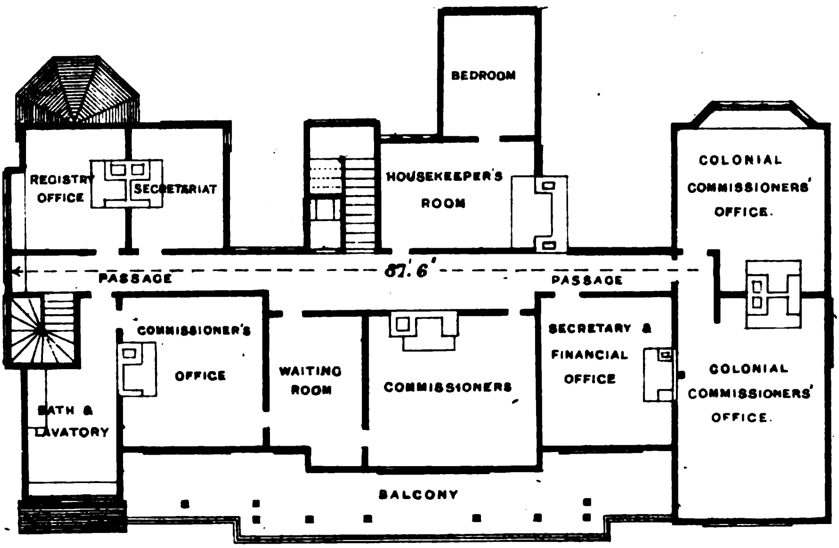
GROUND FLOOR.

Dangerfield Lith. 22 Bedford St Covent Garden

ST GEORGE'S HOUSE.



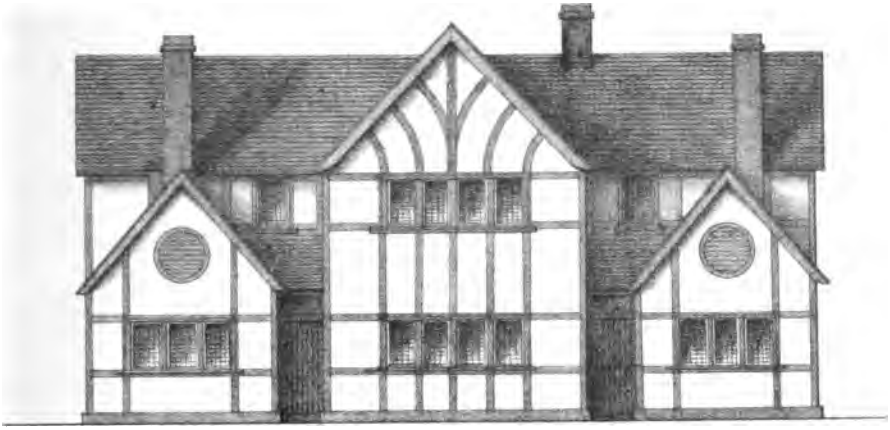
BACK ELEVATION.

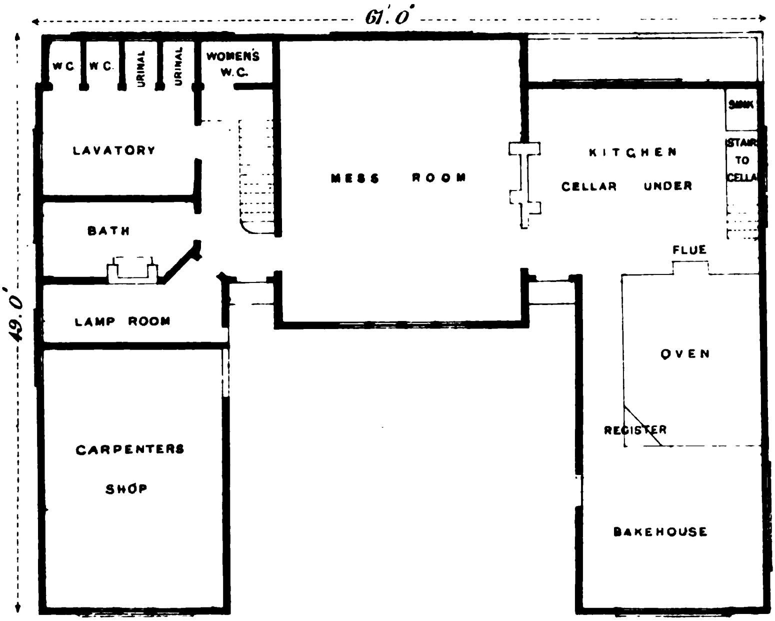


FIRST FLOOR.

Dangerfield Lith 22 Bedford St Covent Garden

WORKMEN'S QUARTERS.

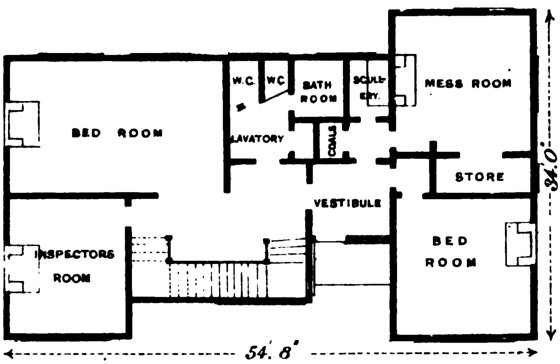




GROUND FLOOR.

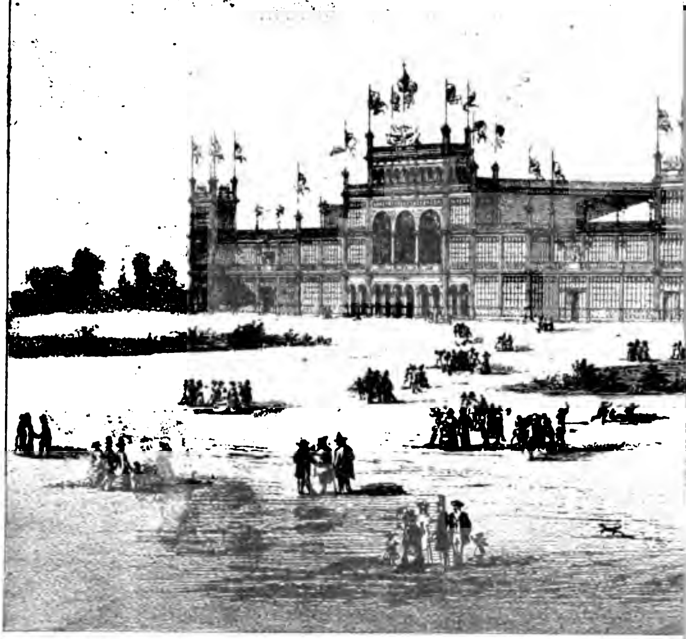
BARRACKS.

FRONT ELEVATION.



GROUND FLOOR.

Dangerfield Lith 22 Bedford St Covent Garden.



Length, 1876 ft } *Area*
Breadth, 464 " } *870, 464 sq. ft*
Height, 70 "

IN

FAIRMOUNT PARK

REPORTS.

Mr. ISAAC LOWTHIAN BELL, M.P., F.R.S.

IRON MANUFACTURE OF THE UNITED STATES, AND COMPARISON WITH THAT OF GREAT BRITAIN.

Report on the Iron Manufacture of the United States of America and a comparison of it with that of Great Britain, by Isaac Lowthian Bell, Esq., M.P., F.R.S., late President of the Iron and Steel Institute.

In conformity with the instructions with which I was honoured by Her Majesty's Commissioners for the International Exhibition at Philadelphia, I presented myself at the Conference of the Judges held in that city on the 24th of May last.

Objects in Group I. The group, No. 1 in the official catalogue, to which I had been appointed, comprised—

Minerals, Mining, and Metallurgy, including the Machinery.
Metals, Metallurgical Products, and Processes.
Machines, Tools, and Apparatus of Mining and Metallurgy.
Mine Engineering, Models, Maps, and Sections.

Judges. The following is a list of the gentlemen who were intrusted with the authority to examine and deliver a verdict on the merits of the numerous objects comprised within the group in question :—

Addy, Matthew, Iron Merchant and Manufacturer, Cincinnati, Ohio, U.S.
Akerman, Richard, Professor of Metallurgy, Stockholm, Sweden.
Althans, Ernst, F., Inspector of Mines, Breslau, Germany.
Axtell, S. B., Sante Fé, New Mexico, U.S.
Barcena, Mariano, Mexico.
Bell, I. Lowthian, Iron Master, Great Britain, President.
Broadhead, G. C., Professor and State Geologist of Missouri, U.S.
Cortazar, Don Daniel de, Mining Engineer, Spain.
Fritz, John, Manager of Ironworks, Bethlehem, Pennsylvania, U.S.
Holley, A. L., Civil Engineer, New York, U.S.
Hunt, T. Sterry, LL.D., F.R.S., Professor, Boston, Mass., U.S.
Jossa, Nicholas, Mining Engineer, Russia.
Jottrand, Achille, Mining Engineer, Belgium.
Keyes, W. S., Mining Engineer, Eureka, Nevada, U.S.
Kjerunf, Dr. Th., Professor, Christiania, Norway.
Nicholsky, L., Mining Engineer, Russia.
Prime, Frederick, jun., Professor, Easton, Pa., U.S., Secretary.
Safford, J. M., Professor, Nashville, Tennessee, U.S.
Savage, Austin, Mining Engineer, Boise City, Idaho, U.S.
Simonin, L., Iron Manufacturer, Paris, France.
Valton, F., Iron Manufacturer, Terrenoire, France.

Nationality of Judges. It will thus be seen that one half the judges of this group consisted of citizens of the United States and the moiety of other gentlemen from Europe. This division is not unimportant as the duty to be performed was a comparison, in practical skill, of the different nations whose works had to constitute the subject of examination. It is only proper to add that among the American judges there was on all occasions a generous desire to do full justice to foreign competitors. Further, the distinguished compliment was paid to the strangers by electing as President of the group one of the judges sent by a foreign government.

Division of work. The immense number of objects presented for inspection rendered it impossible for any single individual to have examined all: besides, no one person could be expected to possess the requisite knowledge over so vast a field, for the proper discharge of his judicial duty.

The work was, therefore, apportioned among the twenty above mentioned gentlemen, the selection being made according to the fitness of each for the particular province he was willing to undertake.

Each sub-division to furnish its own report. Separate reports from these subdivisions of the group are in course of preparation. It was decided, however, that each of these documents

should emanate from a single member and he alone be responsible for its contents. Although it fell to my lot to examine more or less in detail the general work of my fellow judges, I do not propose in this report to deal with any subjects beyond those of Coal and Iron to which my attention was, during my two months' sojourn in Philadelphia, more particularly directed.

Scope of present report.

The present almost complete interruption of our former very extensive commercial relations in iron and steel with the United States, and the expectation entertained by some of seeing these relations re-established, impart no small degree of interest to the examination in question. In its pursuit I propose to avail myself not only of the information I obtained while officially engaged at the Exhibition itself, but also of the knowledge I acquired during personal visits to all the great iron ore regions of the States, to most of the principal coalfields and to a great number of the iron and steel works of this vast country.

Mineral wealth in Exhibition.

United States.

Australasia.

One of the first impressions created by a general survey of the contents of the Exhibition Buildings at Philadelphia was that certain minerals, in the possession of which our own country was formerly conceived to be exceptionally favoured, are in point of fact to be found in great abundance all over the world. The United States have already given ample proof of wealth in the means of supplying their own demand for iron and steel, and if huge blocks of iron ore and masses of coal are to be accepted as a criterion of the resources of our Australian settlements, that which America has accomplished in later years bids fair to be imitated at our Antipodes when circumstances permit it and the necessity for the establishment of iron works arises.

Foreign exhibits of iron.

Whatever the indirect inducements may be, it is generally speaking those of a direct commercial character which determine the conduct of manufacturers in connection with such exhibitions as that recently held in Philadelphia. The expense and trouble of preparing and superintending the arrangement of the necessary specimens at a place three thousand miles from home deter many from the task. This was very apparent upon the occasion in question. Great Britain, producing half the pig iron in the world, was represented in a country consuming nearly one-fifth of the earth's production by a very few firms, of which but a small number occupies a position of any importance. This was also pretty nearly the attitude of Germany, of France, and of Belgium; all apparently expected no practical consequences to themselves to result from the necessary outlay.

Sweden.

Sweden is differently circumstanced and acted accordingly. The high quality of her iron still secures a certain outlet for the products of some of her forges of the first class. This country was, therefore, most creditably represented and in a manner worthy of her ancient repute as a source of some of the best iron known in commerce. Not only were the specimens themselves of extraordinary strength and excellence of manufacture, but the Swedish exhibition was conspicuous by the scientific character of its arrangement.

Swedish Iron-Masters Association.

The Jeru Kontor or Swedish Iron-Masters Association sent maps of the iron bearing districts of the country, collections of the minerals they employ, drawings of ironworks, and analyses of the ores and of the resulting products.

Catalogue in itself a history of Swedish iron-making.

The catalogue itself of the exhibits of this nation is a concise compendium of the process of manufacture pursued in the Swedish iron works and furnishes a proof at how early a period the close dependence of successful manipulation on scientific knowledge was recognized in that kingdom. This enlightened career has been pursued in this ancient seat of the iron trade down to the present day, for it may be said that to the labours of Swedish metallurgists is due the successful introduction of the Bessemer process. This modern invention, when applied to the less pure form of pig of Great Britain, was a failure, and it was only when the ironmasters of Sweden demonstrated its practicability that the subject again attracted attention in this country, when, at the suggestion of Mushet, Spiegel-eisen was found to be a corrective of the impurities contained in our crude iron.

The Swedish Government further exercised a sound discretion in sending as its representative Professor Akerman who, along with scientific attainments, possesses a complete practical knowledge of the art of making iron, combined with a thorough acquaintance with the methods pursued at the works in every part of the world.

I may also observe that Sweden, along with specimens illustrating the high excellence of her products, exhibited large pieces of metal work, proving that her iron manufacturers were keeping up with the rest of the world in the power to supply those massive parts of marine engines required by modern steam navigation. High excellence of exhibits.

Russia still maintains some correspondence with the United States in the finer and more expensive kinds of iron, which like the charcoal brands of Sweden are in request among the steel makers. The effect of this relation was to some extent apparent in the exhibits in the Russian section, although they were vastly inferior to the Swedish display. Russia.

While the European seats of the iron trade, with the exceptions just mentioned, played so inconspicuous a part in the American exhibition the same remark does not apply to the British Colonies, for they, in objects appertaining to Group I. were on the whole admirably represented. From Canada, owing to its proximity, this was no more than might have been expected; but quite equal, and in some respects perhaps superior to the Dominion, were our dependencies in Australia from which innumerable products and, as far as present circumstances permitted, manufactured articles also were displayed. British Colonies. The Dominion. Australia.

Immense pains had been taken, as well as great expense incurred by those interested, to place before the visitors of the Exposition as complete a picture as possible of the apparently immense resources of that quarter of the globe. Without determining to whom to assign the first place among our colonies, all concurred in regretting the absence of Mr. Richard Daintree, whose health had broken down under his incessant labours in connection with the Queensland department. By this misfortune this gentleman was deprived of an opportunity of witnessing the successful fruits of his exertions. Queensland.

Several forgings of malleable iron, shaped by means of hydraulic pressure, were among the articles sent by Prussia; but perhaps as the most worthy objects of notice may be mentioned a 50 ton gun from the works of Mr. Krupp, and armour plates from the establishments of Sir John Brown and Co. and of Messrs. Cammell and Co., of Sheffield, the latter intended for the protection of ships of war from shot thrown from such pieces of ordnance as that from Essen. Prussian exhibits. British.

It is perhaps worthy of consideration by our manufacturers, whether it is altogether prudent for the largest iron making community to be absent even in a country where no customers are to be expected. Visitors from all corners of the earth were congregated, and it was remarkable with what attention those from China, Japan, and other remote countries examined every article brought for inspection. Who knows how soon they may be large consumers of rails, cast iron pipes, and steam engines? Doubtful wisdom of abstinence in exhibiting.

Our colonies seem to have had more foresight. They did not send shiploads of their produce from the opposite side of the globe in the hope of selling iron or corn to America. They did this in order to proclaim to the whole world the existence of mineral and other resources, and to announce to this great industrial Congress by visible signs, as they did by plain language in their catalogues, that their wealth only waited for capital and human skill to render it available for the use of mankind. Opposite course taken by colonies.

We may now pass on to what must constitute the chief object of this report; I mean the display of material, raw and otherwise, along with the appliances in use by the iron manufacturers of the United States. Exhibits of United States.

I do not think that I shall expose myself to the charge of exaggeration in saying that the means afforded to the judges of the group of coming to a correct opinion on the various points involved in their verdict, have not been surpassed in completeness upon any similar occasion. Of raw materials, individual manufacturers furnished numerous specimens, and in addition there were exposed for inspection by many of the different States the natural productions of their respective territories. These were systematically arranged; and the State geologist or his representative being present, every possible information was at the command of any one requiring it.

A magnificent collection of ores and other minerals from the Smithsonian Institution at Washington was rendered most instructive by the courtesy of Professor Blake, who was in constant attendance in the Government building. Smithsonian Institution.

No one could fail to be impressed with the belief, that mines capable of furnishing such great masses and variety of ores, and of exhibiting such

immense sections of fossil fuel as were to be seen in the Centennial Buildings, were indicative of the possession of boundless mineral wealth. In like manner without necessarily accepting the high quality of some of the specimens of iron as a criterion of the ordinary run of the produce of the United States, no one could deny that their presence testified a complete knowledge of this branch of metallurgical art. On the other hand the large dimensions of articles of rolled and forged iron and steel, along with their perfect finish and freedom from blemish, gave unequivocal proof of the strength and perfection of the machinery, as well as of the skill of the men employed in their manufacture.

British commercial relations in iron with the United States.

Such further remarks as I may deem it necessary to make on questions relating to mining and to the mode of manufacture in America will be most conveniently reserved until I proceed to describe what came under my notice during the visits I paid to the mineral regions, and to the iron works in different parts of the United States. Before doing this, however, it may be well to say something on those circumstances which have led to an almost complete cessation of our iron commerce with this part of the world.

Imports into United States of certain kinds of iron since 1871.

The rapid installation of about 75,000 miles of railway in the United States at a period when its production of iron and steel was incompetent to meet the enormous demand for these articles rendered large importations a matter of necessity. Practically the country which kept up the requisite supply was Great Britain. So recently as 1871 the weight of rails brought from abroad into the States was 565,701 tons, in 1875 it had fallen to 18,258 tons. The total quantity of rails, pig, and iron of different kinds imported since 1871 has been as follows:—*

1871 - - -	1,185,483 net tons.
1872 - - -	1,224,144 „
1873 - - -	608,923 „
1874 - - -	248,576 „
1875 - - -	141,079 „

The value, including cutlery and other imports of iron and steel, has receded from above nine and a half millions sterling in the first of these years to almost exactly one third of this amount in the last.

American protective duties not the cause of the diminution of imports.

Not an uncommon opinion entertained on our side of the water is that the high protective duties levied on imports into the United States are the chief cause of this annihilation of certain branches of our commerce with that country. This error, for error I think I can show it to be, is the less to be wondered at, seeing the persistent way in which the Iron Masters Association at Philadelphia labour to prove that, but for protective duties, the iron trade in the United States never could have sprung into existence, and, but for protective duties, it might speedily sink into insignificance.

With so eminently a practical people as the citizens of the United States it might be thought that there were special circumstances which rendered the fettering of trade a national benefit in America, while the rest of the world either had arrived or were gradually arriving at a directly contrary opinion.

Opinions of American Iron and Steel Association respecting duties.

Nearly a hundred pages of the last issue of the Iron Masters Report are devoted to holding up the former protective policy as an eminently wise one in Great Britain long after we ourselves arrived at an opposite conclusion, and after 30 years' experience has confirmed us in the wisdom of the change. No importance is attached to the troubles and vicissitudes which overtook our trade in our days of protection while almost every crime and many of our difficulties are ascribed to free trade after their cessation.

It would be quite useless to argue at any length the subject of protection on the grounds taken up in the report in question or to point out the fallacies and even inaccurate statements to be found in its pages. It is assumed that the British iron manufacturers are seeking to engraft free trade doctrines in the American mind in order to recover the ground they have lost in that country. I shall content myself with endeavouring to prove that so far as our iron trade is concerned we may leave the question to be settled by the United States themselves, for I feel satisfied that the abrogation of the present duties would not afford us any permanent relief, although a few privileged persons there might be somewhat inconvenienced by the change.

---

* Annual Report of American Iron and Steel Association to January 1876, p. 181. A net ton is 2,000 lbs.

That the sudden cessation of our commercial relations cannot be traced to any alteration in the protective duties will be seen by an inspection of the following table of the rates imposed since 1861, in which and from the succeeding statement it will be perceived that concurrently with the loss of our American trade the duties were rather diminished than otherwise* :—

Present and former scale of duties.

	Pig Iron.	Iron Rails.
1861 - - -	25*s.*	50*s.*
1862 and 1863 - -	25*s.*	56*s.* 3*d.*
1864 - - -	37*s.* 6*d.*	84*s.* 4*d.*
1865 to 1869 - -	37*s.* 6*d.*	65*s.* 4*d.*
1870 and 1871 - -	29*s.* 2*d.*	65*s.* 4*d.*
1872 to 1874 - -	26*s.* 3*d.*	58*s.* 10*d.*
1875 - - -	29*s.* 2*d.*	65*s.* 4*d.*

Our exclusion from the American market was preceded by the panic which began to manifest its approach in 1873 and for which the iron masters there assert that "Congress was largely responsible. It encouraged the building "of railroads, which were not needed, by giving to railroad companies millions "of acres of the public lands. The building of these railroads has led to the "building of furnaces and rolling mills."†

Actual cause of diminution of imports of iron.

Whatever may have been the cause of the panic, the fact stated respecting the increase of ironworks admits of no question, as appears from the subjoined statement of imports, home make, and consumption of rails of all kinds :—

Railway Bars: Comparison of home manufacture and imports.

	Imports.	Home make.	Total.
	Net Tons.	Net Tons.	Net Tons.
1867 - -	163,049	462,108	625,157
1868 - -	250,081	506,714	756,795
1869 - -	313,163	593,586	906,749
1870 - -	399,153	620,000	1,019,153
1871 - -	565,701	775,733	1,341,434
1872 - -	530,850	1,000,000	1,530,850
1873 - -	258,772	890,077	1,148,849
1874 - -	108,282	729,413	837,695
1875 - -	18,258	792,512	810,770

These figures point to the fact that the consumption of 1875 was nearly 20 % below the home make of 1872, and according to the list of "the Iron Works of the United States," issued by the same body of gentlemen as the report formerly quoted, the "annual rolling capacity of heavy rail mills in net tons" on the 31st December 1875 was equal to 1,940,300 tons, or nearly 2½ times greater than the year's requirements. It was moreover very much larger than had been needed in any previous period, taking the most active (1872) as the basis for comparison.

It would therefore appear that other parties besides Congress have had some share in producing a state of things which led to the "panic." The rail making power, however, in its increase was only a type of what was going on in other branches of the American iron trade.

We may take the so-called Cleveland district in England as an illustration of certain changes which took place in the iron markets of the world. According to the Mining Records the price of pig metal there for some years anterior to the end of 1871 had remained pretty steadily at something under 50*s.* per ton. The production of the entire Kingdom amounted to 6,627,179 tons for 1871, after which it was as follows :—

Prices of British pig iron and annual make.

		Price of Cleveland Iron.
1872 - -	6,741,929	104*s.* 6*d.*
1873 - -	6,566,451	115*s.*
1874 - -	5,991,408	75*s.* 6*d.*
1875 - -	6,365,462	60*s.*

* Gold dollar taken at 4*s.* 2*d.*

† Annual Report of Iron and Steel Association to December 1874, p. 8.—Annual Report to January 1, 1875, p. 154.—Annual Report to January 1, 1876, p. 165.

So that in reality the make in Great Britain was not materially increased during any of the periods of high prices, viz., from 1872 down to the end of 1874.

With every inducement to extend the production the number of furnaces built between 1871 and 1875 in Great Britain was only 62.

Annual make of pig iron in Germany.

Annual producing powers of United States.

No doubt considerable activity was manifested in Germany* and elsewhere to increase the make, but the United States distanced all her rivals in the rapidity and character of this extension. In the year 1870 the actual make of pig iron was 1,865,000†, whereas the present producing power is estimated at no less than 5,439,230‡.

Actual make in United States of pig iron.

The effect of such a sudden demand for labour as that involved not only in this additional make of pig iron, but in the mining operations required for the furnaces, as well as for the new forges and rolling mills which sprang up in great numbers, can well be imagined. The urgency was too great to be satisfied, and in consequence it was found impossible to keep the additional establishments at work, which in the year of the largest production only gave 2,868,278 tons. Other circumstances, no doubt, tended to keep down the make of iron, but these will be most conveniently dealt with towards the close of this report.

America had drawn freely from the mother country to make good her deficiency in the matter of labour, but this addition to her requirements for furnace men and rollers came when the iron trade and its associated industry of mining were in an unusual state of prosperity in England, and it was therefore more difficult than formerly to tempt men earning high wages in their own country to seek employment so far from home.

Seeing now that the price of all kinds of iron was such as to stimulate increased production and increased demand for labour, we have in the case before us dear iron in England, which rules prices all over the world, dear freights and a high import duty, all combining towards the same end. There can be no reasonable ground for doubting that whatever share high prices played in fostering this unheard of increase in production in the United States, the item of import duty is chargeable with its fair share of the mischief; what that share is can easily be estimated from the figures already given.

Increased cost of pig iron in United States, influenced by sudden expansion of make.

The effect of this united influence can easily be traced in the immense increase of cost in the manufacture of pig iron which I copied myself from the books of a well known firm in one of the Northern States.

Cost per ton of Pig Iron.	for Coal.	Ore.	Limestone.	Labour.	Sundries.	Total.
1860	24/4	11/1	4½	6/6	5/6	s. 47/9½
1871	32/10	25/9	1/1	9/9½	8/6½	„ 78/0
1874	41/8	34/7	1/4	10/4	8/6½	„ 96/5½

This statement corresponds with those compiled by Mr. E. S. Baker of the Eastern Iron Masters Association in which the cost, in spite of improvements in the mode of manufacture of pig iron, rose in 23 years from 15 to nearly 34 dollars, and of bar iron from less than 50 to above 90 dollars.§

It will be seen, from the details just given, how largely this great addition to the cost is due to the rise in the price of the raw materials. The expense of winning these was of course materially enhanced by higher wages demanded by the miners, but I will show hereafter that it was not the miners, but a much smaller class of persons to whose share the chief portion of this difference fell.

Wages earned by men in Iron works in U.S.

At the same time it cannot be denied that the money earned by certain workmen engaged in the American iron works, as well as in the mines, could not be regarded otherwise than as exorbitant, when compared with the general earnings of the community. The extent of the difference in this respect will be most conveniently stated when the various divisions of the processes come under examination.

---

* Make of Germany was 1,500,000 tons in 1871, and 2,250,000 in 1872. Report of American Iron Masters Association for 1875, p. 198.

† Report of Iron Masters Association for 1875, p. 164.

‡ Report of Iron Masters Association for 1875, p. 154.

§ Report of Iron Masters Association for 1875, p. 185.

Comparison of wages in U.S. and Great Britain by American Iron and Steel Association.

In the report of the American Iron Masters Association the contrast between English wages and English workmen and those of the United States is thus stated:—

"England is not merry with the daily life of a contented and comfortable and well paid working people. It is on the contrary discordant, rebellious, sullen, embruted, and miserably poor, with the weight of oppression which it has heaped upon those faithful servants of its unworthy ambition. It is a prison pen; a debtors' prison; a great charity workhouse." * * * "British working men are capable of the highest intellectual, moral, and social development, as is shown in the career of their Englishmen, Scotchmen, Welshmen, and Irishmen who have escaped from the shores of their native country to become citizens of that Greater Britain this side of the Atlantic, which protects its labour, rewards industry, educates its children, elevates the family, has no pensioned clergy, offers its best gifts to all alike, defends the weak, honours virtue in humble life, condemns and punishes corruption in its highest officers, and gives to every one who will work for it a home that no public house can rival in enduring attraction."*

The subjects referred to in the above extracts outside the objects of the present report require little or no comment in its pages. There was and unfortunately is still much in our manufacturing districts and elsewhere which is susceptible of amendment. It would, however, be as unsafe to judge Great Britain by the instances quoted by the American Iron Masters Association, as it would be to pronounce an opinion upon the members of the latter from any flagrant instances of misconduct in the United States. Fortunately I have had abundant opportunity of learning that in no place and by no people have the faults of their fellow citizens been more severely censured than in America and by Americans.

Foreign workmen in U.S.

The report† itself admits that in the United States there are "great social "ulcers—nurseries of pauperism and vice; but the large majority of the "paupers of the large cities are foreigners."

Mollie Maguires.

I am sorry to have to admit that I heard more complaints at the mines and iron works respecting emigrants from Ireland than respecting those of any other nationality whatever. During a recent trial at Pottsville in Pennsylvania, the world learnt with surprise that the mining community of that district had been "struggling under a reign of terror, which had extended over 20 years." The leaders of the society (Mollie Maguires) "were prominent men in the townships." Under the direction of this atrocious body, "county commis- "sioners, high constables, chiefs of police, candidates for associate judges, "men who were trusted by their fellow men were all the time guilty of "murder." This and other crimes had been pursued for 20 years with impunity, recourse being had to "perjury and false swearing for the purpose of "rescuing a criminal from the just vengeance of the law."‡

These tales of horror are, in the speech of the learned counsel (F. B. Gowen, Esq.), set down to the Irish, but it would seem almost incredible that such an extensive organization as is described can have existed for so long a period without its ramifications in some shape having extended beyond the society of the Irish immigrants.

Strikes in U.S.

Leaving, however, the general question of national superiority, and confining myself to the iron trade, I must be permitted to observe that those engaged in it on the other side of the Atlantic meet the labour difficulties they have to contend with, and they are neither few nor small, much in the same spirit as that to which we ourselves are accustomed.

So far as I could learn, discontent among workmen was not confined to any particular nationality, indeed I heard from an American roller himself, that he had been on strike for nine months because he considered something like two pounds a day was as little as he ought to earn. An ordinary wage in England for his description of work was under one half of this sum.

Effects of high wages in U.S.

On the other hand, it was stated not only by the employers but by shopkeepers as well as by many careful workmen with whom I conversed, that

---

* Report of Iron Masters Association for 1875, p. 50.

† Report of Iron Masters Association for 1875, p. 57.

‡ Extracts from Arguments of F. B. Gowen, Esquire (President of Philadelphia and Reading Railroad), in the case of "The Commonwealth *v.* S. Thomas Munley, 1876."

high wages in many cases had only led to intemperance and extravagance. Generally, therefore, I consider that the comparison drawn in the report of the Iron and Steel Association between American and British workmen and their relations with their employers cannot be substantiated.

Wages in England and in U.S.

Further on I shall show that at the periods of my two visits (1874 and 1876), wages in many cases were no higher in the States than in England; and that in the former, whatever may be our practice, high profits to the capitalist in America did not necessarily mean high earnings by the labourer.

Dwellings of workmen.

In the matter of houses I am bound to confess that in the anthracite regions in particular excellent dwellings were provided for the miners, but not superior to those now commonly built in the counties of Northumberland, Durham, and in the North Riding of Yorkshire.* If there are abodes of a different stamp in the United Kingdom, we should have no difficulty in finding in some of the largest cities in the United States, in certain mining localities I know of, and in some agricultural districts I visited, the last mentioned being inhabited by undoubted Americans, very wretched hovels, which would be as great a reproach to any community as any dwellings which are to be found in a land which has, according to the Iron and Steel Association Report, only succeeded "by the degradation of British working men."†

Cost of living.

The cost of living, in other words what his money will buy, is as important to the working man as the amount of his pay. The result of frequent inquiries on the relation the one bore to the other led me to infer that in the opinion of many of our countrymen any advantage in the latter in the United States was all or more than all absorbed by the greater dearness of the former.

This, looking at the immense exportation of articles of food from America to Great Britain, seemed to be somewhat surprising, but so far as I could form an opinion on the matter I arrived at the conclusion that there was little or no foundation for the complaint. It is true that in the item of board and lodging more is paid by unmarried men than in our country, probably in many instances as much as 20 per cent. This might give countenance to the opinion that however cheaper the wholesale prices of provisions were, when supplied in retail they were dearer. In some cases, as in flour, there seems some ground for this belief, but taken as a whole I have no doubt the food of a working man is sensibly cheaper in the United States than with ourselves. The higher charge therefore for board and lodging in America must be ascribed to the housekeepers there being unwilling to incur the trouble attendant on having lodgers upon the same terms as housekeepers are content with in England. This source of increased expenditure necessarily does not apply to a man living in his own domicile.

Clothing on the contrary as well as house rent and firing are somewhat dearer there than with us. I could not, however, satisfy myself that the margin here was not a small one, and that two or three pounds per annum would not cover any additional cost in clothing for a single man.

On the whole, therefore, I am inclined to set down much of the dissatisfaction I heard of on the score of expensive living to a natural proneness among a certain class to exaggerate the inconveniences of the day, and I was led rather to believe the better order of workmen, who, as a rule, admitted that they had improved their position by the change of home.

Truck system in U.S.

There are, however, to be found at many ironworks and mining districts shops or "stores" from which the people employed are supplied by the owners with the necessaries of life. It is, in point of fact, the truck system, and in some cases I met with the truck system in a very objectionable form. It must not be understood that the mode of conducting the business of these establishments was such as always to constitute an unmixed evil, or that upon every occasion the men themselves or even rival shopkeepers were found complaining of any oppression exercised by the iron masters or mine owners. It is, nevertheless, not to be denied that there are instances where the cost of living was materially enhanced by the additional profit levied on those whose

* These examples are given only because I am most familiar with what is done in my own neighbourhood.

† A. I. and S. Association Report for 1875.

position compelled them to submit to the terms of such a monopoly as that in question. The workmen are settled with once a month or once in three months, and the small balance, if any, is paid in cash; but in one case it was stipulated that their entire earnings had to be received in goods. The excuse for this was the depressed state of trade, the return from the shop constituting the only advantage from carrying on the works. The absence of profit, however, from the ordinary business of an undertaking did not by any means comprehend all the reasons for the adoption of the principle itself, for I was informed by the chief director of an iron furnace which gave during the first four years of its existence an average return of 120 per cent. per annum on its cost, that one tenth of this or 12 per cent. was due to the shop.

Dearness of money in U.S.

A difficulty which besets any industry sought to be established in the United States is the dearness of money. This cannot be a matter of surprise to any one cognizant of the rapid strides made in every direction during the last 15 years. In 1869 the mileage of railways in operation was a little above 30,000, in 1875 it was about 75,000. Between 1870 and 1875, the iron making power has been more than doubled, and what adds to the inconvenience connected with the capital account of the works engaged therein is their enormous cost. This owes its origin to dear iron, dear materials of all kinds, and in many cases to dear labour. An instance was given me by the builder of a blast furnace of only medium dimensions, which, constructed in times of high prices, cost 65,975*l.*, or fully twice as much as a similar structure in Great Britain. For it the cast-iron work was charged nearly 21*l.* 5*s.* per ton, and the boilers 42*l.* 5*s.* A more economical iron maker gave me 28,000*l.* as the cost of his furnace, which was capable of running 15,000 tons of pig iron a year. If we take the interest at 5 per cent. beyond that payable in this country we have 1,400*l.* as a higher charge to be supported by such a furnace in the United States than in England, or to make allowance for its extra cost, say 2,000*l.* per annum. The duty, however, levied on 15,000 tons of pig iron over and above the protection afforded by freight say from England would be more than ten times 2,000*l.*

The usual difficulties of sinking collieries in England are such that we shall not be far from the truth in assuming that for similar power of coal mining not above one-half the outlay is incurred in the United States of that expended in this country. The freight from Great Britain to the seaboard of America, may therefore be regarded as far more than a sufficient protection to American raised coal without the charge of 3*s.* 1½*d.* imposed for duty.

Weight attached to home manufactures in U.S.

Great force is attached by Americans to the immense advantage of providing the farmer with a ready market at his own door, and no one will deny that unless the position is acquired at the expense of sound commercial principles, there is much to be said in its favour.

The State of Indiana. Change in its views from Free Trade to Protection as manufactures replaced agriculture.

The population of Indiana is probably about 1¾ millions, and so far back as 1870 its agricultural produce was estimated at something above 2½ millions sterling, and is probably far more at the present day.* Ten years ago it was essentially agricultural and indeed may be still so regarded. Upon the occasion of my first visit, I examined a pork curing establishment at Indianapolis where 1,600 animals were slaughtered every day, and of these no inconsiderable proportion found its way to Great Britain. The inhabitants of Indiana were formerly in favour of any policy which was likely to promote their intercourse with ourselves, and believing free trade the best calculated for this, the members sent to Congress, according to my informant, were antiprotectionists. About 1867, an iron furnace or two were built, the total number now in existence is nine, and the estimated annual make is 71,000 tons, or about 90 lbs. per inhabitant per annum, that of Great Britain being close on 400 lbs. But this production, along with a similar development of other branches of industry, have led the people of this State to do their best to exclude a return cargo from one of their best customers by sending as their representatives to the national legislature gentlemen pledged to the maintenance of a high tariff.

Failure of the high tariff to protect State manufactures.

What must be highly unsatisfactory to such political economists is, that in spite of the protective duty of 28*s.* per ton, most of their furnaces are out of blast, extinguished, not by the dreaded pig iron from Great Britain, but by the

* Ninth Census of United States.

produce of those States which along with themselves are so loud in favour of protection to native industry, protection which in this particular case has utterly failed to secure its chief recommendation of providing a customer at the farmer's door in Indiana.

Scarcely second in importance to the argument just referred to is the alleged necessity of fostering a new industry. Surely if under the nursing influence of a protective duty America has called into being twice as many ironworks as the country requires it is time to consider whether further inducement, if inducement it be, is necessary for adding to the evil. Is there, however, any substantial plea for such a ground? The Bessemer process is one of recent introduction, so much so that 10 years ago no one could boast of great experience in the manufacture of steel by the so-called pneumatic mode. In the successful adaptation of the less pure varieties of pig iron England had gone through a most costly apprenticeship when certain American gentlemen visited our Bessemer steel works, and profiting by our experience, and thus avoiding our causes of failure, established similar works in the United States. There, with suitable ores in greater abundance than we possess, they had no difficulty in procuring pig iron of the proper quality, but in order to nurse this new born industry a protective duty of *5l.* 12*s.* per ton, or 80 per cent. on the present selling price of steel rails in this country was considered indispensable.

The Bessemer process; the Americans profiting by our experience.

This general system of high duties must even in the eyes of a protected American steel maker be occasionally attended with inconvenient results. Taking the ore employed at the Bessemer works at its actual cost it will not in many instances exceed 20 °/ₒ of the cost of a steel rail. If protection is a mode of giving the most employment to the working men of the United States, anything which would give cheap ore, and thus promote the expenditure of the remaining 80 °/ₒ of the cost of rails, was surely worthy of consideration. The fracture of this link of protection was, however, never even hinted at by the steelmaker who himself along with the coal owner constituted the remaining portion of the chain. The price of the support the mine owners afforded to the rail makers in maintaining a high tariff on Bessemer rails was submission to an import duty of 20 °/ₒ *ad valorem* on iron ore.* I shall hereafter have occasion to describe the effect of a very sudden demand on the mining resources of the country, but in the meantime it may be stated that one firm imported something like 20,000 tons of ore from Algeria at a cost equivalent to about 70*s.* per ton on the pig iron made at works 80 miles from the seaboard where I saw it.

Some objections to import duties.

In the minds of some American protectionists an import duty necessarily and entirely means a tax on the exporter; thus, "China is made to pay "a tax upon her tea sold to the British islands; Brazil upon her coffee; "Germany upon her beer and spirits; the South of Europe upon its "currants, raisins, and figs; and the United States upon her tobacco and "distilled grain, &c. These taxes are restrictions upon the free exchange "of commodities." The writer then proceeds to point out certain objections to the conduct of Great Britain in her taxation of certain commodities. This line of action, although in some instances at variance with the doctrines of free trade, is defended by some on the ground of revenue, and is levied in the case of spirits on British and Foreign manufacturer alike. The American protectionists have, in my hearing, attempted to justify the duty on iron on the same ground, forgetting that the object of the duty was to bar its importation. To the assertion that "taxes are restrictions upon the free exchange of commodities," no one can demur, and a few words how this may act to the injury of the United States may have a certain appropriateness.

Fluctuations of rates of and freight of pig iron from Glasgow.

Between the years 1867 and 1871 the freight on pig iron from Glasgow fluctuated between 20*s.* and 24*s.* per ton, and in the latter year the importations into the United States of certain forms of iron was 1,185,483 tons. In 1875 this had fallen to 141,079 tons † when the freight receded to 1*s.* 9*d.* The import duty on pig iron being 29*s.* it follows that at the present time the expenses of transport are almost as much less than they were in 1871 as the whole duty, and yet the export is not one fourth of what it was five years ago.

* American Iron and Steel Association, 1876, p. 15.
† American Iron and Steel Association, 1875, p. 181.

Again, Great Britain imports on an enormous scale grain of various kinds, but vessels earning freights in one direction only, pursue their calling under great disadvantage, as is illustrated by the following statement :—

Indirect influence of protective tariffs on exports due to the increased rates of freight.

A steamer carrying coals from Great Britain to Constantinople, and loading back wheat from the Black Sea, requires about the same time for the voyage as she does from this country to New York. At the present rates of freight the earnings of a vessel able to carry 1,000 tons of cargo in the two cases would be—

Voyage to Constantinople and Black Sea and return:

		£	£
Freight on 1,000 tons of coal	16*s.*	800	
do. 1,000 „ wheat	27*s.*	1,350	
			2,150

Voyage to New York and back:

		£	£
Freight on 1,000 tons of grain	31*s.* 6*d.*	1,575	
Cost of ballast on outward voyage		25	
			1,550

From these figures it appears that a shipowner would, were he to undertake the latter voyage, earn 600*l.* less than by going to the Black Sea in order that he might bring back a cargo of wheat for which the American shipper would receive considerably less than his Russian competitor. It can scarcely be doubted what the effect of a continuance of such conditions would be, or indeed without specifying any particular rate of freight, there can be no question that timber will be brought to this country from the Baltic, cotton from Egypt, and wheat from the Black Sea in vessels carrying cargoes both ways upon lower terms than from the United States in ships going out as they do now almost invariably in ballast. Wheat no doubt may and will come from America, but it will be upon the condition of the grower there paying the additional freight due to the enforced insulation of his farm.

United States in their iron making capacity.

We may now proceed with the examination in detail of the circumstances natural and otherwise which influence the position of the United States in its ironmaking capacity, as compared with that of Great Britain.

Royalty rents paid in Great Britain.

In this latter country the minerals, coal, iron ore, and limestone are vested in the owners of the soil, and dues by way of royalty are such, that the landowner will receive from 5*s.* to 10*s.* upon each ton of rails we manufacture.

Rents paid in U.S.

In the United States the soil itself, and of course the minerals, are in the first instance the property of the respective States, and the governing body in new settlements is too glad to find a purchaser of lands at a merely nominal price, even when they are known to contain valuable minerals. Something like 5*s.* an acre, and even less, suffices to acquire the freehold of large tracts of ground containing valuable deposits of coal or ore, and timber, and sometimes all three. Under such circumstances any charge for lordship dues is too trivial to enter into the account.

Results of opening up lines of communication.

As the industry such territory is capable of maintaining is developed, as population increases, and as profits stimulated either by natural or artificial causes advance, its tonnage rents or its fee simple augment in value. In 1840 the output of the entire region of anthracite coal was 1,000,000 tons. In 1875 it reached 21 millions. Some years after 1840 the price paid for permission to work this valuable kind of fuel was practically nothing; to-day as much as 2*s.* 9*d.* per ton is paid for rent. Twenty years ago timber lands containing rich iron ore near Lake Superior, were to be had for 5*s.* an acre. In 1873 a patch of 40 acres of land, upon which 4,000*l.* had been spent in opening out a mine, was sold to the present holders for more than 70,000*l.* In some of the Southern States the old condition of things still obtains. The lands are remote from the chief markets, and in consequence large tracts can still be had on the terms mentioned, as being those originally paid in the northern portion of the country.

Under such circumstances as those just described, it would only mislead were an attempt made to generalise a charge like that referred to, and therefore the only safe plan will be to notice its amount when such a step is rendered necessary.

Conditions affecting cost of raw material.

The chief remaining expense, in some cases almost the entire expense, therefore of procuring the raw materials is more or less one of labour, and in

estimating the cost of this, several matters are required to be embraced in the computation. We have thus to consider,—

the rate at which labour is paid;

the amount of labour required to produce a given result, this varying with differences in the natural condition of the substance itself;

the quality of the products;

the skill employed in their extraction; and the geographical relations they bear to each other, as well as to the principal markets.

Fuel of United States.

Commencing with the fuel required in the iron works of the United States, it may be stated that coal hewers in Great Britain work very much shorter hours than they who are engaged in a similar occupation in America. The difference is contained in the statement which follows, and in it is the amount of work and the pay received:—

Comparison of work and wages in Great Britain and U.S.

	Hours in pit.	Hours at actual work.	Tons of coal per day	Daily net earnings. s.	d.	
Great Britain:						
Coal hewers, Durham	6.41	5.39	3.90	5	0	house and firing free.
Do. Northumberland	6.40	5.52	3.15	6	9	house and firing free.
South Wales	9	—	3.00	4	6	
Do.	—	—	2.60	4	8	
Staffordshire	5 to 8	—	7.00	5	3	
Do.	7	—	5.00	5	0	
Scotland	9	—	2.50	4	2	
Do.	10	—	2.85	4	0	
Do.	10	—	3.00	4	0	
America, Northern States:						
Anthracite	10	—	6.00	18	10	
Bituminous	—	—	4.00	9	0	
Do.	—	10	10.00	9	6	
Do.	—	8 to 10	8.80	9	10	
Do.	—	10	5.00	8	6	
Southern States:						
Bituminous	—	8 to 9	3.00	7s. to 9s.		
Do.	—	—	2.75	7s. to 9s.		

Great Britain.

It should be stated that the above earnings in Great Britain are those of the present day, the average being about 5*s.* 2*d.* per diem, or about 11¼*d.* per hour of actual work. In 1874 the rates were something like 25°/₀ higher, equal therefore to 1*s.* 2*d.* per hour, for which the quantity worked was about 11 cwts. per man. To the earnings given of the Northumberland and Durham mines must be added about 1½*d.* per hour for house rent and firing, which is paid for in the United States by the colliers.

America.

In America the wages at the period of my first visit had not as yet been generally reduced, although such a change was spoken of on all sides. The hewers got 13 cwts. of coal, and were paid about 1*s.* 1*d.* per hour in 1874. It thus appears that for similar periods, and for like amounts of work, the advantage is rather on the side of the pitmen of this country when compared with those of America; certainly such is the case in the North of England.

Employment of convicts in Southern States.

In connection with the cost of labour in coal working may be mentioned the employment of convicts in a few of the collieries in the Southern States. In one instance as many as 300 were so employed, their services being farmed from the State, upon such terms, that after adding the price of food, cost of armed watchers to prevent escape, and other expenses, a given amount of labour is obtained for considerably less than one half of that paid to free men.

A coal owner in Georgia gave as one reason for the employment of these poor creatures that their presence tended to keep down strikes. Whatever may be the cause, the free workmen regard the presence of criminals with great aversion, and in consequence the two are kept, as far as is practicable, apart.

Description of coal deposits of U.S.

Lie of country permitting of

The seams of bituminous coal of America in thickness resemble our own, *i.e.* they run from 3½ to 6 feet, and in one instance at Connellsville in Ohio, the well known coking seam there is 10 to 11 feet. They are usually worked at depths of a very moderate character, rarely beyond 100 fathoms, and more frequently under half this. In many places the stratification and the intersection of the surface of the country by valleys admit of the coal being

worked by adits or drifts. This enables the seams to be reached at very little cost, 2,000*l.* in many cases sufficing for an opening capable of affording 300 to 400 tons per day. driving adits in lieu of sinking shafts.

I heard of coal of the quality under consideration obtained so easily, that delivered at the pit's mouth its cost did not exceed 3*s.* per ton, but looking over the long series of figures I collected, I feel that an average of 5*s.* will amply represent all expenses, including say 6*d.* per ton for royalty, of working bituminous coal in the United States. No one with any acquaintance with the cost of coal in Great Britain, will be disposed to consider that we enjoy any advantage in this important element, of which something like 35 to 40 millions of tons are at present annually required in our iron works. Low price at pit's mouth.

As an unquestionable proof of the low cost at which coal can be wrought in the softer seams may be quoted the price of Connellsville coke, the most esteemed fuel of its kind in the United States. To make one ton of it from 32 to 40 cwts. of coal will be consumed, and yet the coke itself was being put into the wagons at the pits at 5*s.* per ton, or not more than half the price which Durham coke commands at the present time. Connellsville coke.

In addition to coking coal, districts are wrought which give a dry burning coal fit for using raw in the blast furnaces, as is done with Scotch splint and similar varieties in Great Britain.

The fuel, however, which is the envy of all iron-smelters is the anthracite. It ought to be as cheaply won as any other coal seams I examined, and probably in many cases is so. If a moderate cost of production is not always attained it is because of an attempt to establish a monopoly which two years ago I ventured to predict would end like a similar one in the North of England in disappointment, and which will be considered further on.

The seams of anthracite sometimes reach a thickness of 20 or 30 feet. They form long ridges of which the anticlinal axes frequently come close to the surface. At Mauch Chunk I visited a working on the summit of such an axis where the coal had been quarried in open day from a face of 50 or 60 feet. Mauch Chunk quarries.

The openings for working anthracite, or slopes as they are called, follow the coal down the side of the ridge, so that the produce of the pit is drawn up an inclined railway plane. A large timber erection known as the "breaker" continues the plane to a considerable height. By properly contrived machinery the coal is cleaned and sorted into different sizes to fit it for the market. An establishment of the nature just described for giving 240,000 tons a year costs about 30,000*l.* which is certainly below the expenditure for sinking many collieries of similar power in this country.

We have then anthracite almost as cheaply worked as the coking coal in the county of Durham, but with this distinction, that anthracite is for the purposes of the smelter almost equal to a similar weight of coke, inasmuch as it contains a very small quantity of those volatile constituents which render it indispensable to sacrifice above one-third the weight of such coal as that of the county of Durham in the process of coking.

In Great Britain the quantity of anthracite is extremely small, so that the total weight of pig iron made by its means in 1875 was only 29,889 tons.

The only trustworthy mode of testing the quality of fuel is by ascertaining the work it is capable of performing. Analyses however carefully made are analyses of specimens which may or may not represent the bulk. Indeed the determination of the calorific power by actual experience is liable to considerable disturbances by differences in the appliances in which it is burnt. Quality of coal of U.S.

Looking through the numerous analyses which came into my possession and consulting other sources of information, I have no reason for supposing that the coal fields of America do not contain fuel quite as pure and quite as suitable for iron purposes as the average of the produce of our British collieries.

Before concluding these remarks on coal I will add the quantities worked during the year 1875 by the five largest producing countries in Europe, by which it will be seen that the United States stand second in point of importance:—

Great Britain.	United States.	Germany.	France.	Belgium.
Tons.	Tons.	Tons.	Tons.	Tons.
131,867,105	46,500,000	45,645,193	16,949,031	14,407,082

In area of coal-bearing strata however the United States, according to present information, rank far above every other nation, the estimated superficial contents of its coal fields being about 200,000 square miles against 8,000 in Great Britain. Any other remarks on the extraction and use of pit coal will be best reserved for a future occasion.

Natural gas in U.S.

Although we have nothing in England corresponding, at all events in quantity, with the natural gas now being introduced as a means of heating iron, it would be wrong not to mention the fact of its existence and application in the United States. On boring through the strata on the confines of the oil regions immense accumulations of light carburetted hydrogen are met with, and such is the confidence reposed on its continuance that a firm near Pittsburgh has laid a pipe 17 miles in length to convey the gas to their works. Upon the occasion of my visit 250 tons a week of finished iron was being made almost exclusively by this gaseous fuel. The "gas well" itself cost under 2,000*l.* and it is capable of doing the work of more than 500 tons of coal per week. The quantity required to make a ton of puddled iron was stated to be only 3,500 cubic feet. If this be correct, as a ton of gas coal contains nearly three times this quantity, and one ton of coal at least is consumed in puddling every ton of iron, it follows that there is an immense advantage in burning gas instead of solid coal.

Utilization for furnaces.

Charcoal.

The gradual disappearance of forests in Great Britain and the magnitude of its iron trade have banished charcoal from our smelting establishments. In a new country like America where thousands of acres of timber lands can be purchased for a few shillings per acre, this valuable species of fuel is still largely employed in the blast furnaces. The figures which follow exhibit the annual make of pig iron since 1870 classified according to the fuel used in its manufacture : †

	Anthracite.	Bituminous Coal and Coke.	Charcoal.	Total.
	Tons.	Tons.	Tons.	Tons.
1870	930,000	570,000	365,000	1,865,000
1871	956,608	570,000	385,000	1,911,608
1872	1,369,812	984,159	500,587	2,854,558
1873	1,312,754	977,904	577,629	2,868,278
1874	1,202,144	910,712	576,557	2,689,413
1875	908,046	947,545	410,990	2,266,581

Thus the average quantity of charcoal iron smelted during the last 6 years is nearly one-fith of the entire make.

Cheapness of wood.

Notwithstanding the extreme cheapness of wood as it stands on the ground, the forest never can supply a low priced fuel. The labour in felling the timber, conveying it to the hearths, and charring it is very great, and this tells heavily on the product which on an average does not exceed one-fifth of the weight of the raw material.

The best lands yield about 40 to 45 cords per acre, but some of the less productive will not give above half this quantity.‡ From these figures I have estimated that nearly 80 square miles of forest are annually sacrificed in the United States* for iron making furnaces, and the wood employed will weigh nearly 3 millions of tons. Something like 30 years is required for the growth of timber, so that it may be assumed that the annual produce in charcoal of an acre is under half a ton.

The advantage of fossil over vegetable fuel will be readily understood when it is remembered that 200 acres of a 4 feet seam of coal will afford the same weight of coke as 50,000 acres of wood will give of charcoal.

---

* There are probably not 2,000 tons per annum of charcoal iron made in the United Kingdom at the present time.

† Report American Iron and Steel Association for 1875.

‡ A cord contains 128 cubic feet measured as the wood is piled.

	Per Ton of Charcoal.				
	s.	d.		s.	d.
The labour of cutting timber costs -	4	9	to	6	6
ditto for burning - -	6	9	„	12	6
"Stumpage," *i.e.*, purchase of wood as it stands in the forest - - -	0	6	„	1	0
	12	0	„	20	0

The lower charge (6*s.* 9*d.*) for burning is where the operation is performed in kilns, and is an exceptional mode of treatment. In northern latitudes where the winter lasts for six months kilns are a necessity, but being costly (nearly 6,000*l.* for each blast furnace) and inconvenient from all the timber having to be conveyed to them, they are generally dispensed with wherever this is practicable.

No rule can be laid down of the cost of leading the charcoal to the furnaces, this being of course dependent on the distance which varies from one to fifteen or twenty miles, the nature of the road, &c. The simplest plan will, therefore, be to quote the figures given to me as the cost of charcoal laid down at the smelting works in different localities:—

	Per Ton.		Per Ton.
Michigan - -	34*s.* 3*d.*	to	37*s.* 8*d.*
Ohio - - -	—	„	31*s.* 8*d.*
Virginia - -	27*s.* 7*d.*	„	31*s.* 8*d.*
Missouri - - -	24*s.*	„	38*s.* 7*d.*
Kentucky - -	—	„	24*s.* 3*d.*
Tennessee - - -	—	„	33*s.* 2*d.*
Alabama - -	25*s.* 4*d.*	„	38*s.* 7*d.*

Annual production of ore in Great Britain.

According to the Memoirs of the Geological Survey 15,821,060 tons of iron ores were extracted from the mines of Great Britain in 1875, which along with 738,693 from other sources gave 16,559,753, say 16½ millions as the total quantity dealt with during that year.

These consisted of—

	Tons.
Clay and calcareous ironstones, chiefly the former, from the lias formations of North Yorkshire, Lincolnshire, Northamptonshire, Oxford, Wiltshire - - -	8,300,000
Clay ironstone of the coal formations in Scotland, England, and Wales - - - - - -	4,700,000
Hematites of different kinds, including a small quantity of spathose ore - - - - -	2,250,000
Imported, say - - - - - - -	750,000
	16,500,000

Ironstone of Lias formation in Great Britain.

In the Cleveland hills the Liassic bed of ironstone varies from 7 to 17 feet in thickness, and is so free from foreign matter that usually every thing worked in a mine finds its way into the blast furnace. The following shows for the years 1874 and 1876 the work performed and earnings of the miners, who are 7½ hours underground, and work about 6¾.

	Tons worked per day.	Net earnings of miners.	Tons worked per annum per total men employed.
1874 - -	5·137 -	7*s.* 0*d.* -	600
1875 - -	5·500 -	5*s.* 5*d.* -	622

The yield of this stone varies from 27 to 31 °/ₒ, and its cost at the present time delivered at the furnaces will average from 16*s.* to 20*s.* on the ton of iron.

In Lincolnshire and Northamptonshire this variety of ironstone, from lying so near the surface, is got by open work, and is procured on even cheaper terms than in North Yorkshire; besides the advantage of position, it is capable of being worked by comparatively unskilled men, who are content with a lower rate of wages than the miners in Cleveland.

Its average yield however is only about 25 % in Lincolnshire, but it reaches to 35 or 40 % in Northamptonshire.

Annual production of ore in U.S.

Of the first named in the series, viz., the lias, America possesses no equivalent, and in estimating the other varieties, not having at my command any general statistics of all the States, I have been compelled to use the information I possess of the quantity of iron produced in different localities for the same year as that to which the figures respecting Great Britain apply, making due allowance for the mill and forge cinder returned to the smelting furnaces.

In this way I have calculated the relative quantities of the different ores smelted in the United States to be as follows for 1875 :—

		Tons.
Clay ironstone - - - - - - -		750,000
Hematites and oxides :	Tons.	
Lake Superior - - - - -	1,000,000	
Lake Champlain - - - - -	350,000	
Cornwall Banks, Pa. - - -	150,000	
Missouri - - - - - -	250,000	
New Jersey - - - - -	400,000	
Brown ore and red fossiliferous in various States - - - - -	1,200,000	
Sundries - - - - - -	250,000	
		3,620,000
		4,370,000

The above must be regarded as only approximate, but will be sufficiently close to the truth to enable us to consider the position of some of the chief iron making centres in regard to the supply of ore.

Clay ironstone of U.S.;

The chief part of the clay ironstone of the carboniferous measures is the produce of the districts known as the Hanging Rock situate in Southern Ohio and Northern Kentucky. A certain quantity is obtained and smelted at Johnstown in Cambria County, Penn., and quantities of inferior importance are worked in other localities.

The mines of the Hanging Rock region contain a layer or seam not exceeding 15 inches in thickness, and in those at Johnstown two bands are worked together having a united thickness of 24 to 27 inches.

In the Hanging Rock district a man's day's work varies from half to three quarters of a ton. In 1874 the wages amounted to about 7*s*. 6*d*. per ton, to which it was reduced from 11*s*. 4*d*. in the cost for labour in 1873. At the former price the miner's earnings fluctuated from 3*s*. 9*d*. to 6*s*. per day of eight hours' work. The cost of the stone delivered at the furnace was, at the period of my visit, about 15*s*. per ton, and its yield 40 %.

of Staffordshire.

It is difficult to compare this American ore with the clay stone of Staffordshire, the conditions under which the latter is obtained vary so greatly. This much, however, may be said generally that the cost is fully as much or more than that paid in the Hanging Rock region. The present market price of claystone is 18*s*. per ton in Staffordshire, and the average yield is about the same as that in America.

Wales.

In Wales a trifle above half a ton was as much as a miner could obtain for a day's work, for which, some years ago, he received 3*s*. 9*d*., equal to 7*s*. 6*d*. per ton. With the general rise in the price of labour almost all the workings of native ironstone have been discontinued in the Principality, so that clay ironstone of the coal measures is but little used at present in the Welsh iron works.

In percentage of iron the claystone of South Wales resembles that of Johnstown, *i.e.*, both are poor. The hewer's wages per ton, at the latter place, however, do not exceed the half of that paid in Wales.

Black Band ironstone in Great Britain. In U.S.

The valuable variety of ore known as Black Band, which constitutes half the clay ironstone found in Great Britain, occurs over a very extended area in the United States. I saw it in the Mahoning Valley and in that of the Tuscarawas in Ohio, and as far south as the coal fields of Alabama. It is, however, in the Valley of the Tuscarawas alone that it has been commercially employed in any quantity, and even there at the present moment I believe

that all or all but one of the half dozen furnaces of the district are out of blast. In every case where I examined it, the percentage of iron is much below that worked either in England or Scotland, 40 instead of about 60 % being its yield in the calcined state. In the Tuscarawas district the Black Band has only been worked in patches of 5 to 10 acres, as it forms either the caps or a stratum, near the tops of the small hills near the river. In some cases it is only a few inches in thickness, at others it is a bed 10 feet and upwards, instead of 12 to 30 inches as it occurs with us. In composition the American Black Band is so silicious as to be somewhat refractory in the furnace, but when properly treated it yields a metal greatly resembling Scotch pig in quality.

From what has preceded, it will be readily understood that the amount of a man's day's work in the Tuscarawas Valley differs much according to the nature of the seam. The entire labour on a ton of rawstone was (1876) about 3*s.* on the raw stone, while in Scotland it is about 3*s.* 4*d.* for hewing 32 cwts., to which at least as much more must be added for other sections of labour required in a pit where the seam rarely exceeds 18 to 24 inches.

Iron ores of the oxide class in Great Britain.

In Great Britain the chief portion of the ore in which the iron exists as an oxide is the so-called Red Hematite. In the United States the metal in this state of combination is found as specular ore, magnetite or magnetic oxide, and red and brown hematite.

In the following account of these varieties, it will not be necessary always to specify the nature of each, because in some places, as in Lake Superior, more than one is found, and because physically there is not much, if any, difference in their mode of extraction.

Lancashire and Cumberland are the two counties in which by far the most important quantities of red ore are obtained, they furnishing nearly 90 % of the production of the United Kingdom.

The payment for royalty ranges from 2*s.* to 3*s.* or 4*s.* per ton. In some cases for mines leased during the years of high prices, viz., 1872 and 1873, even larger dues were willingly paid. For seven hours of actual work the miners earn about 5*s.* 6*d.* getting from 1½ to 2 tons, and the cost under the most favourable circumstances is, I am informed, not under 10*s.* 6*d.* to 11*s.* at the mine, the selling price being from 11*s.* to 14*s.*

Iron ores of oxide class in U.S.

For practical purposes the condition in which the ore occurs in England and in Lake Superior and Lake Champlain may be regarded as identical. In both cases it is found more or less in large pockets passing occasionally into the nature of a true vein. The mode of winning it is by quarrying, as well as by close work, but the latter is, owing to the nature of the deposits, much more frequently practised in this country than in the two districts above-named of America.

Lake Superior mines.

The mines of the Lake Superior district are situate in a country stretching between Escanaba and L'Anse, although by far the greater portion is obtained in the immediate vicinity of Ishpeming and Negaunee. In certain places in some of the mines immense masses of ore are found free from any admixture; at others actual blocks of foreign matter are interposed, or as frequently happens, the ore passes gradually into the nature of the adjoining rock. The following figures were given me as showing the relative quantity of sterile matter to be dealt with at two of the mines in this district. There was raised in one year—

Merchantable ore - - -	134,937 tons -	133,000 tons
Rock or poor ore - - -	52,466 „ -	62,000 „
Water - - - -	387,809 „ -	not given.

The changing proportion in which ore and rock are found of course influences materially the amount of labour required in obtaining the marketable commodity.

Produce per day and per year of one mine.

In one mine producing above 130,000 tons a year, 1·06 ton of ore was given me as the quantity raised per man per day for the men, all told, engaged on the spot. The hewers earned gross 7*s.* 1¼*d.*, leaving 5*s.* 6*d.* to 6*s.* 6*d.* after paying for explosives. At others the prices paid per ton run from less than 2*s.* up to 7*s.* per ton, according to the admixture of useless matter which has to be removed, but counts as nothing.

In another locality 2·19 tons per man employed per diem was given as the output. As a rule the earnings of the men may be considered in 1876 as being about one half of what they were in 1873, but they are still about

30 $^{\circ}/_{\circ}$ higher than the rates paid in 1856, the period of opening out the mines of this neighbourhood.

From the particulars given me, the cost at which ore can be put into railway wagons at the mine will vary from 6*s*. 6*d*. to 8*s*. 6*d*. per ton. The yield of metal is from 60 to 66 $^{\circ}/_{\circ}$, which is above that of the North-west of England, 50 to 56 $^{\circ}/_{\circ}$, being the produce of the latter.

In the figures quoted as the cost of the Lake Superior ores nothing is set down for rent, the lands containing them having, as a rule, passed into the possession of the present owners for less than 5*s*. per acre. The present selling price of the ore varies from 15*s*. to 17*s*. per ton at the mines.

The openings from which ore is obtained in the Lake Superior region are two or three hundred feet in length, one or two hundred wide, and a couple of hundred feet deep, beyond which depth the ore rarely extends. In some cases, as at the Republic and Michigamme mines, the ore deposit is more in the form of a vein; in the first almost upright, and in the other more horizontal, with a considerable dip.

In the district under consideration some mines have been exhausted, and in others the expense of working the ore has been increased by the greater depth at which they are now carried on. The very profitable nature of the enterprise led many adventurers to flock to the neighbourhood. New winnings were made only to be abandoned, after fruitless expenditure, and every thing was done in order to satisfy, as far as possible, the growing demand for ores, which being sufficiently free from phosphorus to make Bessemer pig, were in great request for the steel works. I believe the largest quantity obtained in any one year was a little over a million tons, and there are those in the district, who say not only that this cannot be exceeded, but that unless fresh discoveries are made there will be a sensible diminution in a very few years of the first class ores.

Largest quantity obtained in one year over 1,000,000 tons.

Menominee district.

Considerable deposits of a similar character are said to exist at Menominee, lying to the south of the mines just referred to. A railway is being built 15 miles in length, but up to this time no quantity of ore has been obtained from this locality. The State geologists and others, however, speak favourably of its extent and quality.

Iron ores of Lake Champlain district.

The general terms in which the pockets of ore found in northern Michigan have been described are in a great measure applicable to those near Lake Champlain. The largest opening, that of Port Henry, presents a remarkable sight. The ore is obtained partly by open and partly by close mining, the former about 250 feet square by 250 in depth, and the latter a continuation of the mineral deposit to the dip. From the present floor of the quarry or open portion a bore hole of 140 feet passed through pure ore without reaching the rock. The roof of the mined portion of the excavation is supported by five colossal pillars of pure ore estimated to weigh 70,000 to 80,000 tons. The mineral is pierced with steam drills by miners who earn about 6*s*. 7*d*. per day of 10 hours. The output is about two tons per day per man employed, all told. I did not learn the cost, but comparing the circumstances of its extraction with those of Lake Superior I see no reason why it should not be equally as cheaply wrought as the Michigan mines, which added to 2*s*. railway dues for 7½ miles, will give 8*s*. 6*d*. to 10*s*. 6*d*. as the cost at the lake side, the former being probably nearer the mark. The selling price varies from 20*s*. 8½*d*. to 28*s*. 3½*d*., an average being 24*s*. The yield is from 60 to 62 $^{\circ}/_{\circ}$, but it contains too much phosphorus to be useful for Bessemer steel: indeed it is somewhat remarkable that this great ore deposit was first worked for apatite or phosphate of lime for the artificial manure makers, for which object it proved a commercial failure.

There is, however, another vein of small dimension, which is being worked and smelted at Crown Point on the lake, which furnishes good Bessemer pig iron.

I have given 350,000 tons as the yearly output of the Lake Champlain mines, but their capability is considerably more, probably at least half a million tons per annum.

Cornwall Banks.

About 85 miles on a westerly direction from Philadelphia is the deposit of iron ore known as Cornwall banks. Its percentage of metal is much below that of the two preceding districts, being only 50 to 55 $^{\circ}/_{\circ}$. It is perhaps the most cheaply worked mass of ore in the world. It lies in the form of a ridge

nearly three quarters of a mile long having a width of 500 feet, and a height in some places of 350 feet above the surrounding plain, and a depth below it of 50 to 180 feet.

The ore is so soft in texture that a man for a day's work can blast and load 10 tons into the wagons which ascend the hill by a spiral locomotive railway cut in the ore all the way. For this he receives, looking at the value of the ore, the moderate pay of 4*s.* 8½*d.*, or about 5½*d.* per ton, and I was unable to see how a couple of shillings would not amply cover all expenses connected with its extraction. The present selling price is from 11*s.* 6*d.* to 14*s.* per ton.

The produce of Cornwall banks is contaminated with sulphur, possibly the most sulphureous ore of its kind in the world. This deleterious ingredient is in a great measure removed in the blast furnace by the copious use of lime, and the ore being free from phosphorus the resulting pig iron is in favour at the Bessemer steel works.

The producing powers of this remarkable accumulation of ore are very large, probably if fully exercised amounting to some thousands of tons per day; but the largest quantity sent away in any year was 220,000 tons, the firm who own the property preferring a small output for reasons of a commercial character.

Iron Mountain of Missouri.

At a distance of about 80 miles in a south-westerly direction from the city of St. Louis lies the Iron Mountain, and in its vicinity are the mines of Pilot Knob and Shepherd Mountain. The mineral of the specular variety is very hard and dense. The first mentioned and by far the most important of the three is an irregularly shaped deposit in many places of clean solid ore of various thicknesses up to 70 or 80 feet. Taking the mine, however, as a whole, for every cubic yard of useful material obtained, three times this bulk of barren rock has to be moved, hence for every man engaged on the ground the daily weight of merchantable product does not exceed 20 cwts. The working hours are from 6 to 6 with one hour for dinner, for which the miners receive from 4*s.* 6*d.* to 5*s.* 3*d.* and house rent free.

The cost of raising the ore was not communicated to me, but it probably did not (1874) exceed 6*s.* The railway dues are high 1¼*d.* per ton per mile, which brings the cost, if I am correct, to 13*s.* 6*d.* at St. Louis, the present selling price being about 26*s.* 6*d.* at that city and the yield about 72 °/₀. In former times it was delivered at 20*s.* 6*d.*

One thousand to twelve hundred tons per day have been sent from the Iron Mountain mine, some of which is forwarded to Chicago and other distant places. Several of the blast furnaces of the Carondelet, near St. Louis, are now idle on account of the unremunerative state of the trade, so that the mines are not in full work, the owners apparently preferring to be idle to reducing their price for the ore.

The mineral at Pilot Knob occurs as a bed or seam about 30 feet in thickness. It is very hard and in consequence more expensive to work than that obtained at the mine just described. It is also less rich in metal, being only 56 or 57 °/₀. At the period of my visit (1874) little or nothing was being done in working the Pilot Knob mine.

New Jersey.

In quality the ores of New Jersey belong chiefly to the class known as magnetite, but the deposits, being thinner than those already described in Michigan, Pennsylvania, and Missouri, are more costly to get.

The output of the largest I heard of was under 50,000 tons per annum. The ore lies in veins varying in width from a foot or two to 40 feet, but in the larger masses foreign matters are interspersed. The cost under circumstances differing so widely varies very much. The miners were earning 5*s.* 8*d.* to 7*s.* 6*d.* per day which brought the labour from 8*s.* to 10*s.*, so that 12*s.* to 14*s.*, including 2*s.* for rent, will probably represent the cost-price of the ore at the pit's mouth. The per-centage of iron is about 55, but the content of phosphorus unfits the New Jersey ore generally for Bessemer purposes.

The yearly product of the New Jersey mines figures in my table for 400,000 tons and on referring to the Geological Survey I find 300,000 tons was the output for 1867.

Brown ore.

In various localities among the elevated regions of the Appalachian chain and in the adjacent low lands, as well as elsewhere, are found deposits of the hydrated peroxide of iron or brown iron ore. In the north of the Union it lies

in patches of greater or lesser magnitude. I examined such a working from which ore intended for furnaces in the Lehigh valley was being excavated. The mineral lies in a kind of loose gravel, partly in the alluvial covering and partly in the rock. It contains so much foreign matter that it requires washing, after which it does not yield 35 °/₀ of iron. In this neighbourhood it occurs in the lands of small farmers who receive 2*s*. to 2*s*. 9*d*. per ton by way of rent, so that delivered at the furnaces 12*s*. to 13*s*. represents the cost per ton of the ore. It contains more phosphorus than the magnetic ores of New Jersey, and for the better kinds of pig iron made in the Lehigh valley is only used in small quantities.

As we proceed southwards true veins of brown ore in the rocks are met with. In the Virginian section of the mountain range just spoken of, I inspected such a deposit, nearly 24 feet wide, and standing in a nearly upright position. The former influence of slave labour on wages is still felt in Virginia, and hence the miners were only receiving 3*s*. 9*d*. to 4*s*. 8*d*. per day, during which a good man would break down and load 3 tons of this ore. At this rate the actual cost of mining was not above 1*s*. 9*d*. per ton. The produce of the vein, worked open, was carted down a mountain road, and delivered at the furnace for about 6*s*. 6*d*. per ton. This is exclusive of any payment for rent, the lands being the property of the owners who had acquired them for 20*s*. per acre. The ore yielded about 50 °/₀ in the furnace.

It is, however, in the States of Alabama and Georgia that the largest deposits of brown hematite are to be met with. The produce is from 45 to 50 °/₀ of iron, and its mode of extraction so easy and cheap, that the cost is under 5*s*. per ton delivered at the iron works, which are usually in the immediate neighbourhood of the mine. In one case a farmer of convict labour delivered the ore at the furnace for 7*s*. 6*d*. on the ton of iron made, which left him, according to my information, a very handsome profit.

Low as the foregoing prices may appear to be, I greatly doubt whether the best brown ore deposits have as yet been broken into. I examined, alongside the Alabama and Chattanooga railway, an elevated ridge about a mile in length by a quarter of a mile in width, and judging from the appearances in the water courses, from trial holes and from the outcrops of the subjacent rock, I arrived at the conclusion that this ridge for a thickness of 150 to 200 feet was probably solid ore. In other places there were equally good grounds for believing that this mineral was to be had in great abundance.

To an English ear this language may bear the impress of exaggeration, but it must be remembered that the iron ore mines of Somorostro at Bilbao are very much of the character just described.

The ore miners in Alabama do not earn more than 3*s*. 9*d*. per diem. It ought to be mentioned that although the brown ore of the South furnishes, particularly when smelted with charcoal, a very fine class of foundry iron as well as forge, the presence of phosphorus is, I understood, too great to permit the pig being used in the Bessemer converter.

Red fossiliferous ore.

At various points in the Appalachian chain and its offshoots a stratum of iron ore known as the red fossiliferous occurs. At one point overlooking Jones' Valley in the State of Alabama, it is found 30 feet thick, but of this a considerable portion is inferior in quality, being poor in metal and very rich in silica. About 8 feet, however, of the top of the bed is good, yielding in the furnace from 33 to 50 °/₀ of iron. It forms the uptilted slope of a hill with a covering of only a few feet of rock. The workmen were paid 3*s*. 9*d*. a day, at which the cost of extraction was under 2*s*. per ton, so that including haulage to the ironworks, the expenditure for ore per ton of iron did not exceed 7*s*. 6*d*..

The fossiliferous ore differs a good deal in composition. At one time it is essentially silicious, and at another calcareous, neither of these varieties separately or together being very suitable for furnace work, but with an abundance of aluminous brown ore obtainable at no great distance, admirable mixtures are within reach of the smelter.

Further north in Tennessee the bed thins, and involves greater labour in the extraction from the mine, costing about 10*s*. 6*d*. per ton at the works, part of which increased expense is due to the miners receiving from 4*s*. 8*d*. to 5*s*. 7*d*. per day, instead of 3*s*. 9*d*. as in Alabama.

As we proceed northwards this bed of fossiliferous ore gradually diminishes in thickness, and although I saw it at the works on the banks of the Susquehanna, it no longer constitutes an important item in the supply of the blast furnaces.

The iron obtained from the fossiliferous bed is of fair quality, but is utterly unfit for steel making of any description.

There are other deposits of iron ore in the United States remarkable both for quality and quantity. Among such I was assured may be classed that in the Cranberry vein in North Carolina. It has been worked at its eastern extremity on a small scale for some years, and has recently been traced for miles in a westerly direction through the Smoky Mountains, where I examined it. This report cannot, however, do more than deal, and that in a very general way, with those ore deposits which have either been made available in a large way for the actual supply of the iron works, or which, from their known resources and present means of communication, are in a position speedily to constitute an important addition to the present means of supply.

Taking all the iron ore raised in Great Britain, I have estimated its average percentage of iron will be a trifle under 35 °/o, whereas the produce of the mines of the United States, similarly considered, will be about 56 °/o, which means that for each ton of iron made, there is 20 cwts. less ore to be dealt with by the American iron master than by ourselves. This in smelting charges, and particularly in the matter of transport, is a very important distinction. Comparative richness of ores in U. S. and in G. B.

In addition to the richness of an ore, proper consideration must be given to its comparative freedom from deleterious ingredients, and this has become a subject of great importance since the introduction on so large a scale of the Bessemer process. In this branch of manufacture, much above one tenth of a unit per cent. of phosphorus renders pig iron unfit for the operation. An ore containing therefore about one-twentieth of a unit of phosphorus is useless, because practically all this substance existing in the ore finds its way into the pig. Comparative purity of ores of U. S. and of G. B.

Of such ore, less than 12½ per cent. of the total quantity raised in Great Britain is fit for the Bessemer works, equal to about 17 °/o of the present annual make of pig iron; whereas in the United States almost one-third of the produce of its mines is sufficiently free from phosphorus to furnish iron fit for Bessemer purposes.

The frequent occurrence of limestone in different geological periods renders the case an exceptional one when the iron smelter fails to secure the necessary flux for his operation on easy terms. To this abundance, and to its facility of quarrying, 4*s.* to 5*s.* per ton at the furnaces may be considered an outside price in Great Britain, and in some places, such as South Wales, 2*s.* 6*d.* will be nearer the mark. The cheapest limestone I met with in the United States cost 2*s.* 6*d.*, and the dearest 6*s.* 7*d.* The extent to which this substance enters into the manufacture of iron is usually, when using mineral fuel, 15 cwt. per ton of iron, and with charcoal it is often under one-third of this quantity. An exception to these proportions is when the limestone is rich in carbonate of magnesia, thus at certain of the Pennsylvanian furnaces this impurity is present in the flux to the extent of 30 °/o. In such an event 20 cwt. in the place of 15 was required, and the smelter was thus passing 5 cwt. of inert matter for every ton of his product through the furnace, thereby increasing his consumption of fuel required in the process. Limestone.

No great space need be devoted to any minute contrast of the skill exercised by the United States and ourselves in the extraction of the raw materials used at the iron works. Differences in the physical condition of the mineral itself, render differences of treatment unavoidable, and this of course does not permit the institution of a very rigid comparison. Higher wages than ours have made every appliance having a labour-saving tendency of somewhat greater importance in America than in our own case. At the same time I cannot in any of the mining operations there remember any striking instance of superiority in this respect over ourselves, and in some a distinct disregard of economy was perceptible. It is, however, perhaps not necessary to travel out of Great Britain in order to discover notable examples of defective arrange- Mining skill of U. S. and G. B.

ments. The machinery generally employed on the American mining establishments will compare favourably with those I have visited in any part of Europe.

Geographical distribution of raw materials.

I now come to a consideration of the last of those conditions which materially affect the economic value of raw materials, viz., their geographical relation to each other, and that of their product to the markets of the world.

Comparison between distances in U.S. and Great Britain.

The vast extent of the territory of the United States renders that possible, which in Great Britain is physically impossible; thus it may, and it does happen, that in the former distances of nearly 1,000 miles may intervene between the ore and the coal, whereas with ourselves it is difficult to find a situation in which the two are separated by even 100 miles.

I propose at present to examine the effect of this difference of conditions, and having already shown that America in the mere possession of the raw material is at least as well placed as ourselves, I shall proceed to examine whether the geographical disadvantage under which, in certain cases, she labours, is such as to require any special favour for the development of her iron industry.

A useful element in such an investigation as that just named, and an interesting one in other respects, will be a table of the producing powers of different forms of iron in the various States of the Union in which the manufacture is being carried on. From the list we can then select some of the most important, in order to illustrate the immediate subject of the present inquiry.

Tabulated Statement of the Iron Works in the United States, with their respective Annual Producing Powers.*

States.	Blast Furnaces.		Malleable Iron Works.			
	Number.	Capacity in Tons.	Puddling Furnaces.	Capacity in Rails.	Capacity in Other kinds.	Total.
			No.	Tons.	Tons.	Tons.
Michigan	34	268,160	31	18,000	14,000	32,000
Wisconsin	14	109,700	34	44,800	25,000	69,800
New York	57	529,500	309	169,000	191,400	360,400
Pennsylvania	279	2,264,900	2,153	684,500	940,500	1,624,500
New Jersey	18	183,600	172	15,000	126,300	141,300
Ohio	99	863,320	669	292,000	342,600	634,600
Indiana	9	71,500	129	71,000	29,600	100,600
Illinois	12	188,000	98	305,000	18,000	323,000
Maryland	24	98,700	99	58,000	33,500	91,500
Virginia	34	72,400	46	—	48,460	48,460
West Virginia	12	99,400	181	25,000	89,500	114,500
Kentucky	23	138,300	160	15,000	89,000	104,000
Tennessee	22	99,400	31	28,000	13,400	41,400
Georgia and Alabama	26	126,400	17	15,000	9,500	24,500
Missouri	19	223,500	68	50,000	44,000	94,000
Remaining States under 50,000 tons pig respectively	31	102,450	269	150,000	235,260	385,260
Total	713	5,439,230	4,474	1,940,300	2,249,460	4,189,760

* Directory of the Iron Works of the United States in 1875.

Distances separating raw materials in Great Britain from furnaces.

In Scotland, Staffordshire, and South Wales, the three older seats of the iron trade in Great Britain, the works are placed on coal fields containing ironstone. For 20 years or more in the West of Scotland, both these materials were obtained almost from the same pits, but this is no longer the case, and in many instances the minerals are brought from greater distances. South Wales has not for 30 years or more done more than obtain one third of the

pig iron produced from native ironstone, the remainder being composed of red ore from the West of England and, more recently, of lias ironstone from Northamptonshire, &c. Generally speaking the workings of ironstone in Wales have now been abandoned, so that with the exception of scoria from the malleable iron works, the furnaces are supplied with ores from more distant localities in the manner explained.

The district smelting Cleveland lias ironstone, of which Middlesborough may be regarded as the centre, is pretty favourably circumstanced. The coke and coal employed at the furnaces are brought from the county of Durham, from distances chiefly of 20 to 30 miles, limestone 40 miles, and ironstone from 1 to 20 miles.

Lancashire and Cumberland have their ore and limestone in the neighbourhood of the furnaces, but the coke goes from Durham, a distance of about 80 or 90 miles.

TABULATED STATEMENT of the approximate Costs of conveying the Mineral required for making one ton of pig iron in Great Britain.

—	Carriage										
	Of Fuel.			Of Ore.			Of Limestone.			Total.	
		s.	d.		s.	d.		s.	d.	s.	d.
West of Scotland -	44½ cwts.	1	9	43¼ cwts.	3	9	14 cwts.	1	2	6	8
" " -	65 "	1	11	38½ "	4	1	14 "	1	8	7	8
South Staffordshire -	40 "	1	6	55 "	2	9	10 "	0	6	5	0
Cumberland - -	24 "	9	7	36 "	4	6	8 "	0	7	14	8
Lancashire - -	24 "	10	0	36 "	4	6	8 "	0	7	15	1
Lincolnshire - -	25 "	9	9	70 "	2	9	0 "	0	0	12	6
South Wales - -	40 "	1	9	45 "	13	6	15 "	0	9	16	0
Middlesborough -	26 "	3	0	65 "	4	0	12 "	1	6	8	6

The united make of the above being equal to five-sixths of that of the entire kingdom.

Applying the data I obtained in the United States, I have estimated the cost of conveyance calculated on the raw materials per ton of pig iron to be as follows:— Conveyance of raw materials to furnaces, United States.

—	Carriage of Coal.			Carriage of Ore.			Carriage of Limestone.			Total Cost for Carriage.
	Cwts.	Miles.	Money.	Cwts.	Miles.	Money.	Cwts.	Miles.	Money.	
			£ s. d.			£ s. d.			s. d.	£ s. d.
Lehigh Valley - -	35	40 to 50	0 8 2	40	30 to 40	0 12 0	20	—	1 0	1 1 2
Philipsburg - -	35	40	0 8 9	40	—	0 9 4	20	—	1 0	0 19 1
Lake Champlain - -	30	330	1 1 0	32	7	0 4 0	5	—	0 6	1 5 6
Cleveland - - -	30 10	90 180	0 11 9	30	600	1 2 6	15	—	1 9	1 16 0
Harrisburg - -	36	60	0 10 2	40	25 to 150	0 10 0	15	—	0 9	1 0 11
Lebanon, Pa. - -	35	87	0 11 9	40	7	0 3 0	15	—	0 3	0 15 0
Hanging Rock - -	40	6	0 6 0	60	5	0 9 0	20	—	1 6	0 16 6
Pittsburg - - -	25	10 to 60	0 3 9	30	—	1 10 0	15	20	1 6	1 15 3
West Virginia - -	25	—	0 11 0	40	2	0 4 0	10	—	1 0	0 16 0
Cincinnati - -	26½	—	0 16 0	30	—	0 19 9	10	—	1 0	1 16 9
St. Louis - - -	32	85	0 18 6	28	—	0 12 6	6	—	1 0	1 12 0
Chicago - - -	27	—	1 3 0	36	—	1 2 0	17	—	1 6	2 6 6
Alabama - - -	40	2 to 5	0 3 0	40	10 to 20	0 5 0	15	—	1 6	0 9 6
Indiana - - -	30	—	0 2 0	35	—	1 15 0	12	—	1 0	1 18 0

These figures are subject to a good deal of variation according to the ores or fuel in use at the time.

Cost of carriage, Great Britain to U.S.

If it is desired to see how any particular locality stands in the item of charges for carriage, the following approximate statement may be taken as a guide in the estimate. In it the Atlantic transport from Glasgow to New York is taken at 15*s.*, which is 5*s.* below the average of former years, and to which 2*s.* 6*d.* is added for dues from the furnaces to the vessel:—

	Carriage on Minerals.			Carriage to New York.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.
Scotland	0	7	2	0	17	6	1	4	8
Cumberland	0	14	8	1	0	0	1	14	8
Lancashire	0	15	1	1	1	11	1	17	0
Middlesbro'	0	8	6	1	3	0	1	11	6
Lehigh Valley	1	1	2	0	7	6	1	8	8

The seaboard of the United States, however, does not comprise the chief centres of consumption, the position of the coal fields being one of the main causes in determining their location. Numerous rolling mills in consequence have been constructed in the Lehigh Valley, partly on account of the pig iron works on that river, and partly on account of the vicinity of the coal pits. To have access to these malleable iron works, &c. of the district in question, the charge of conveying British pig iron from New York (7*s.* 6*d.* per ton) would have to be added to its cost, and deducted from that of the metal made on the spot, so that the figures would stand 32*s.* 2*d.* for British, against 21*s.* 2*d.* for American pig.

Comparison of cost of carriage of raw materials in the U. S. and in Great Britain.

The further we proceed westwards, the more serious does this obstacle to the introduction of seaborne iron become. Pittsburg is a place where the consumption of pig iron is very large, the supply being kept up partly from Pennsylvania on the east, partly from Ohio on the west, and partly from the make of its own furnaces. The last-named it will be perceived are unfavourably situate in the matter of carriage, because the ore chiefly used is that from Lake Superior. The nearest route for this ore will be, 60 miles from the mines to Escanaba on Green Bay, about 580 miles water carriage by Lake Huron to Cleveland on Lake Erie, and 150 from this point by rail to Pittsburg, or a total of 790 miles, with two handlings on the road. The total cost for carriage is thus brought up to something like 20*s.* per ton on the ore. Owing to the mill and forge cinders there being unusually free from phosphorus, they form an important item as a source of iron at the smelting works, so that by their use the actual charge on the pig for transport of raw materials probably does not exceed 25*s.* per ton. The distance, however, from the sea to Pittsburg, is well on to 450 miles, so that 25*s.* to 30*s.* per ton might be safely added to the carriage connected with delivering iron from furnaces in the West of Scotland to the United States, making the entire charge on the ton of British pig more than 50*s.* at Pittsburg.

The great advantage possessed by the mineral fields of the South is exemplified by the cost for transport in the State of Alabama, which compares favourably with the best of those of Great Britain. Localities in Tennessee, and possibly in Georgia, possess powers little, if anything, inferior to those of Alabama,

The contiguity of coal and ore in Alabama, as already explained, gives facilities for iron making, which are perhaps not to be surpassed in the world. To the costs of these something may have to be added for that increase in the value of labour, which any great development of an industry would occasion in the South. With labour, however, on a par with that of the Northern States, Alabama occupies a position rarely to be met with even in America.

The population of these Southern States is such, that at the present day markets would have to be sought in the busier centres of industry of Ohio and Pennsylvania. Pig iron is now being conveyed by rail as return freight to Louisville, a distance of 400 miles, for 16*s.* 9*d.*, where it joins the Ohio ready to be transported by water to Cincinnati, Pittsburg, &c.

For similar reasons to those just given I did hear of iron being sent 1,000 miles, from Chattanooga to St. Louis, for 19*s.* per ton, which is only about ¼*d.* per ton per mile, and from the Rising Fawn furnace to Cincinnati, a distance of 540 miles, for 21*s.* 9*d.* Thus one halfpenny per ton per mile on wagons which would otherwise return empty may at present be counted on.

It is only right, however, to add that a profitable investment to the shareholders in these Southern Railways cannot generally be reckoned among their advantages.

In connection with river transport I may mention the fact of coal being sent down the Ohio and Mississippi for 1,600 miles for the low charge of one shilling per ton. This is effected by embarking 20,000 tons of coal in a flotilla of lighters, and dispatching the whole under the care of one steam tug.

Smaller quantities sent up stream of course are attended with much greater expense than in the case just quoted. Enough, however, has been said to prove that while in the South, ore and coal exist under conditions not surpassed by any in Great Britain, the metal they produce can be poured into the heart of the iron making regions of the Northern States at a total cost for transport little more than one half that involved in bringing the raw materials together in Scotland and in sending the resulting pig to the same point.

From the effect of this influx of iron made in a State outside of Pennsylvania and Ohio, having less commercial interests in common than those which exist between ourselves and many States of the Union, there is and probably can be no protection.

What the precise difference to an iron maker of a less favoured district would be in being undersold by an Alabama iron master instead of by one in Great Britain, were the latter possible, need not upon the present occasion be inquired into.

Smelting works.

Having now at some length described the raw materials as they exist in nature in Great Britain and in the United States, and having compared the amount of labour and its cost attending their extraction and conveyance to the blast furnace, I now propose to examine some of the circumstances more immediately connected with the smelting, and subsequent stages of manufacture.

There is probably no branch of industry which is less indebted to purely scientific research than is the iron trade. Every step from the rude hearth by which a few pounds of ore was reduced to the state of malleable iron, to the blast furnace capable of running two or three hundred tons of pig per week, has been the result of gradual development by the practical iron maker, who possessing no science himself, too often despised it in others. Even the hot blast which bore the impress of some scientific reasoning owes little, if any, of its value to those considerations which induced its inventor to think of applying it to iron smelting.

The last ten years has seen a great change in this respect in Great Britain. If the chemical laboratory is not held to be an indispensable adjunct to every iron work, the lessons it teaches are respectfully listened to by every intelligent iron maker. So far as a very extensive acquaintance with the American manufacturers enabled me to form an opinion on this subject I would say unhesitatingly that they are as fully alive as we ourselves to the importance of careful study of these natural laws which influence their various processes and affect the quality of the products.

Their schools for giving instruction in the various departments of science are numerous, and those which I had an opportunity of examining appeared to me to be admirably conducted. Some among them owe no inconsiderable amount of their efficiency to the munificence of private individuals who have wisely foreseen that the lessons these institutions were destined to teach would form the only trustworthy guides for future generations of iron makers.

The natural, and I may say the deeply cherished feeling, which binds Americans to the United Kingdom, and the prominent position of our iron trade have led many American iron masters to visit what they feelingly speak of as "The Old Country." These visits and their own undaunted energy have kept their works, as a whole, quite on a level with those of Europe. Indeed I am not sure that in some matters it would not repay some of our own manufacturers to go to the American works in order to examine the use to which the lessons taught by our experience have been put. I may perhaps be permitted to say that trade secrets or unwillingness to communicate the fullest information are sentiments which appear to be entirely unknown to mine owners and iron masters across the Atlantic. The experience of every one who has had an opportunity of judging agrees with my own in declaring that nothing can surpass the cordiality of the reception which awaits a British iron master at every furnace or forge in the United States he may please to visit.

In the first step of the manufacture of iron, viz., the smelting of the ore, the American iron masters are only beginning to avail themselves of the results of the advantages derived from a great enlargement of the blast furnace. The value of this change of construction was first demonstrated in the Middlesborough district, and was so apparent that in a year or two every furnace of the older dimensions was dismantled, and others, three or four times their size, were erected in their stead. Notwithstanding the significance of this example, the value of which has been proved by the experience of a dozen years, there were not above a dozen furnaces out of the 713 in the United States much above sixty feet in height, and many were 10 feet lower than this. It has now been demonstrated that an addition of 15 to 20 feet to these dimensions has been attended in many instances with an economy of 20 to 30 % in the fuel consumed.

On the other hand the possession of large and valuable beds of anthracite rendered the successful application of this fuel a matter of paramount importance in the United States. Peculiarities of a physical nature interposed certain difficulties in its use, and these in South Wales have only been partially vanquished; at all events the make of an anthracite furnace has never in the Principality equalled that of one fed with bituminous coal either coked or raw.

In America, chiefly by the use of blast obtained by very powerful machinery at twice the pressure of that commonly used with us, anthracite coal is almost as easily managed as is so much coke.

In the matter of wages at the blast furnaces those paid in America at the period of my first visit in 1874 were decidedly lower than those current on the banks of the Tees, as will appear from the following figures :—

	Wages at North of England Iron Works, Sept. 1874.	Wages in the United States, September 1874.
Keepers	9*s.* 11*d.* per day	7*s.* 6*d.* to 9*s.* 6*d.* per day
Slagmen	6*s.* 2*d.* „	„ 6*s.* 3*d.* „
Chargers	7*s.* 7*d.* „	„ 6*s.* 9*d.* „

For the class of men coming under the general denomination of labourers 4*s.* 8*d.* per day was a common wage in 1874 against 3*s.* 2*d.* to 3*s.* 4*d.* in the Middlesborough iron works.

Notwithstanding the apparent absence of any great dissimilarity in the rates of wages paid at the blast furnaces, the actual cost per labour on the ton of iron was, as a rule, much higher in the United States than in North Yorkshire and Durham. Two circumstances conduced to this end, the British works referred to are all comparatively of recent construction, and are especially contrived for economising labour; and by this with a great produce the tonnage cost is materially reduced.

At Pittsburgh three furnaces of large dimensions have been put into blast within the last year or two, the performance of which, in the quantity of iron they run, has been the subject of comment. The result in question is due to the richness of the ore employed (Lake Superior) and vigorous driving. There are no especial features in the mode of treatment, and the great make (100 tons a day) is obtained at some sacrifice of fuel.

To the smelter accustomed to pit coal the work obtained by the use of charcoal in Lake Superior will be a matter of surprise. Furnaces 42 feet high and only 9 feet at the greatest width have been known to run above 260 tons of rich grey iron in the week, with a consumption of a trifle under one ton of charcoal per ton of pig. Equally good results, however, attend the charcoal furnaces of Austria and elsewhere with poorer ores, so that it is to the materials and not to any extraordinary measures in the operation that we must ascribe the large make and small consumption of fuel in Michigan.

Puddling process.

In the operation of smelting, the iron combines with a certain quantity of carbon and other substances during its passage through the blast furnace. The process of puddling has for its object the separation, more or less completely, of these impurities. In principle it consists of exposure at a high temperature of the melted iron to an oxidizing influence, generally that obtained by the use of oxide of iron. It is therefore essentially dependent on a constant change of surface between these two substances while in a melted state. The iron as it becomes malleable solidifies, and therefore if the incor-

poration of the pig iron with the oxide has not been properly effected, the result is an inferior class of bar to that a given quality of pig is capable of affording.

Severe labour incurred.

The thoroughness of the operation is dependent on such severe labour, that the puddlers as a class have always constituted one of the chief labour difficulties in our iron works. Enough has been said to render it intelligible that a good deal of the success of the process is of a purely mechanical character.

Endeavours to relieve workmen.

Impressed with this, the Dowlais Iron Co. in Glamorganshire, fully 20 years ago, made some very costly attempts to relieve the puddler of the chief portion of his severe work. This was proposed to be effected by keeping the metal in a fluid state in a revolving barrel of refractory material by which the necessary change of surface was to be effected. Simple as this object may appear to be, its accomplishment was attended with so many practical difficulties, that having regard to the actual cost of the puddlers' labour, it was, after an expenditure of about 20,000*l.*, abandoned.

In America, where the price of puddling was considerably higher than in Great Britain, the inducement to supersede hand labour by mechanical agency was proportionately greater.

Dank's furnace.

In 1871 Mr. Samuel Danks, of Cincinnati, U.S., again called the attention of the British iron trade to the subject by a paper he read before the Iron and Steel Institute on a revolving puddling furnace, which, by the introduction of some modifications in the Dowlais furnace, was in successful operation at four or five works in America. A commission was appointed by the Institute to go over and examine the performance of Mr. Danks' invention. The report of those charged with the inquiry was sufficiently satisfactory to induce one firm in Staffordshire, and three in Middlesborough, to make a trial, and in one case an entirely new forge and mill, at a cost of more than 100,000*l.*, were constructed.

Introduction into Great Britain.

A very short experience convinced those who had incurred the outlay that much had to be done before the new furnace could be declared a successful substitute for hand puddling, and such also was the opinion arrived at in America, for I found in the Autumn of 1874 that, with the exception of two works, the revolving furnaces at the others, where they had been tried, were dismantled; and when they were at work no duty was done during the night.

Difficulties in use.

In the meantime English enterprise appeared to confirm American failure, for the new forge referred to had to declare itself insolvent, and the troubles at the other establishments seemed at one time all but insurmountable. These are now in a fair way of being overcome, and although, as I understand, the forge of Messrs. Hopkins, Gilkes, and Co., at Middlesborough, is the only one running at the present moment, and running day and night, there appears every reason for hoping that mechanical puddling before long may be generally introduced in this country.

Fair hopes of being overcome.

Advantages.

The advantage possessed by this system is not the mere superseding of a most laborious manual operation by an employment worthy of the attention of a workman of intelligence; but by the superior manner in which the necessary conditions of the process are observed, the product is of a far better quality than that usually obtained by hand puddling. This is so remarkable, particularly in the separation of one of the most injurious of all the impurities found in pig iron, that I venture to think the application of the revolving furnace is destined to play a most important part in the future history of the iron manufacture of our own country. The assistance it is calculated to render is the more valuable from the fact that phosphorus, the ingredient referred to, is more than usually abundant in the lias ironstone which, as has been already stated, constitutes one half of all the ores raised in Great Britain. By means of this new furnace this impurity in the bar iron has been reduced below that often found in the best British brands got by the use of much purer ores. It possesses the further advantage of enabling the puddler to get a much larger produce of malleable iron from a given weight of pig iron.

Forge machinery of U.S.

In the machinery in use in the American puddling forges there is nothing which calls for especial notice, if we except the squeezer known as Winslow's, which is well adapted for dealing with the large masses of iron now placed at our disposal by the revolving puddling furnaces.

Puddlers' wages.

In November 1874 the price paid for puddling on the Tees was 10*s.* 9*d.* per ton. The following figures were those given me at the same date for the same kind of work in the United States:—

17*s.*, 22*s.* 7½*d.*, 22*s.* 7½*d.*, 18*s.* 10¼*d.*, 20*s.* 8¾*d.*, 22*s.* 7½*d.*, 21*s.* 9*d.*, 22*s.*, 16*s.* 11½*d.*, 17*s.* 10¾*d.*, 16*s.* 11½*d.*, 18*s.* 10¾*d.*, 23*s.* 6¾*d.* 23*s.* 3*d.*, 22*s.* 7½*d.*, 22*s.* 7½*d.*, 19*s.* 11¾*d.*, 24*s.* 6*d.*, 16*s.* 11½*d.*, 16*s.* 11¼*d.*, 22*s.* 7*d.*, the average of the whole being 20*s.* 7*d.*

Since 1874 the price at Middlesborough has been reduced from 10*s.* 9*d.* to 8*s.* 3*d.*, or 2*s.* 6*d.* per ton. During the same period the account of reduction in the United States varies from 2*s.* to 4*s.* 6*d.* per ton, but these concessions from the men have been obtained at the expense of considerable interruptions to work, accompanied occasionally by serious disturbances.

Rolling mills.

Rail mill.

So far as skill of manipulation and general efficiency of work are concerned, I could detect no difference between the old and new country in the rolling mills. I had an opportunity of comparing two rail mills, one turning out 70 tons per turn at Middlesborough, and the other 67½ tons in Pennsylvania. The number of men employed at the two was almost exactly the same, but the cost for labour per ton was fully 25 °/₀ higher in America than in this country.

Bar mill.

In one case which came under my notice in rolling bar iron, I found the price paid in America to be nearly double that paid in this country.

Comparison of mill wages.

The following shows the respective daily earnings of some of the leading workmen in the rail mill at the prices of the present day:—

	United States.		Great Britain.	
	s.	*d.*	*s.*	*d.*
Per day: Furnacemen	12	2	8	9
Do. chargers	5	5	4	3
Pilers	7	10	4	6
Two pilers in America doing work of three in Great Britain.				
Head roller	28	10	23	0
Rougher	12	0	18	6

These prices are calculated upon a mill doing 1,000 tons per week in the United States, against one turning out 800 in this country, so that for the same amount of work 20 °/₀ must be deducted from the American scale, which brings the two into pretty close approximation.

The observations made in regard to the puddling forges for convenience of arrangement and general efficiency apply equally to the finishing mills.

The system of rolling in three high trains is more extensively adopted in the United States than with ourselves, but on minuting the time occupied in finishing a rail, there did not appear so great a saving in this respect as might be imagined.

"Cold Rolling."

One novelty came under my notice, viz., that of "cold rolling," in which bar iron is passed through rolls when cold about a dozen times. The reduction in sectional area is that represented by one-eighth of an inch in thickness in a bar two inches in diameter. The iron comes out with a surface so bright and clean as to serve without futher preparation for shafting, or even for piston rods; and not only is its hardness, but also its tenacity is said to be materially increased.

Bessemer process.

Upon a previous occasion it was stated that some ten years ago the then comparatively infant process of Mr. Bessemer was carefully studied in Great Britain by American metallurgists. Every improvement which experience had mastered in this country was carefully noted by those who had come to examine its features, and any defect in existing arrangements was corrected in the magnificent steelworks and rail mills which since then have been constructed in the United States.

Among those who have rendered great service in this branch of manufacture must be named Mr. A. L. Holley, who, by simplifying the arrangements connected with the converters, has added something like 25 °/₀ to the working capacity of the plant. To the Messrs. Fritz also great credit is due for their ingenious contrivances connected with labour-saving machinery in the steel rail mill. Mr. Holley's improvements and other modifications, similar in nature to those of the Messrs. Fritz, have been applied to the Bessemer works in this country, so that there is perhaps little difference in the effective power between the best works of the two nations.

Fully ten years ago the French set the example of running the pig direct from the blast furnaces into the converter, by which waste of fuel and loss of iron in re-melting were avoided. Apprehensions, needless perhaps, regarding quality, kept our steel makers back for some time from following so promising an example, but these have been got over, and at one or two works in Great Britain the melted crude iron flows direct from the smelting furnace into the converter. So far, however, as I know, there is not a single work in America which has adopted a simple plan by which at least a saving of 5*s*. per ton is realised.

The actual productive capacity of the Bessemer works is, according to the Directory of the Iron Works for 1876, 500,000 tons, chiefly for rails; and this I was informed is greater than the present requirements for the American railways.

The heating furnaces generally employed in the Bessemer works of the United States are those suggested by Dr. Siemens in this country.

The present report has assumed such an unexpected length, that the less important branches of the iron trade must be dismissed with few words.

Catalan forge.

The primitive Catalan forge has entirely disappeared from Great Britain, and is rarely now to be met with in any part of Europe. In America with mineral cheap and rich, and charcoal on the spot, there are 39 forges in which wrought iron is still made by it direct from the ore. Their annual capacity is given at close on 60,000 tons; what the actual make is I have not the means of knowing, but I understand that a good deal of their produce is used by the steel makers. Besides these, there are Bloomaries able to produce more than 60,000 tons of blooms from pig iron by the method still extensively practised in manufacturing the best Swedish and Russian brands.

Bloomaries.

Iron sponge.

An attempt has been made to introduce a modification of the Chenot process by which an iron sponge, as it is termed, was obtained direct from the ore, and the metal so obtained was thrown into a bath of melted pig iron so as to produce steel. The works for the present have been discontinued but for reasons, as the owners assured me, quite apart from the nature of the process itself. At the same time, without pronouncing definitively on its merits, I entertain a much less sanguine opinion of its ultimate success than do its promoters, although I by no means deny in it considerable merit.

Siemens Martin steel.

The plan, known as the Siemens-Martin, of forming steel by fusing wrought and cast iron together, is occupying much attention in the United States, so that it is estimated that the furnaces already in existence are equal to an annual production of 45,000 tons.

Crucible and other steel.

The annual make of crucible steel is given at 45,000 tons, which, with steel known as German, blister and puddled, equals a total capacity of 108,250 tons.*

Some earnings on Continental Europe.

Before proceeding with my concluding remarks on the iron trade of the United States some of the earnings of the workmen employed in the iron-works on the continent of Europe may be considered not altogether irrelevant. Their date is for the year 1873, the period of the highest wages in this country and America; and the figures are interesting as showing the nature of the competition the iron manufacturers of this country have to meet.

	Coal hewers.	Ironstone miners.	Puddlers.		
*Belgium	4*s*. to 7*s*. 2*d*.	2*s*. 6*d*. to 3*s*. 7*d*.	1st hand	5*s*. 6*d*.	12 hours.
	in 8 hours.	per day.	2d ,,	2*s*. 10*d*. to 3*s*. 2*d*.	,,
Silesia	3*s*. 6*d*.	1*s*. 10*d*.	1st ,,	4*s*. 9*d*.	,,
	in 10 hours.	in 8 hours.	2d ,,	3*s*. 2*d*.	,,
Westphalia	- -	- -	1st ,,	4*s*. 6*d*.	,,
			2d ,,	2*s*. 10*d*.	,,
Spain	- - -	2*s*. in 10 hrs.	1st ,,	4*s*. 6*d*.	,,
France	- - -	3*s*. 6*d*. in 10 hrs.			
England	- -	- - -	1st ,,	10*s*.	,,
			2d ,,	4*s*. 7*d*.	,,
America	- -	- - -	1st ,,	16*s*. 4*d*.	,,
			2d ,,	8*s*. 2*d*.	,,

Ironstone of Alsace and Luxemburg.

As regards the possession of ironstone it may be remarked that in Alsace and Luxemburg are vast deposits not unlike the lias beds of this country from

* The above figures are all extracted from the Directory of the iron works, 1876.

which the mineral containing 40 °/₀ of iron can be got at a cost of 2*s.* 9*d.* to 3*s.* 3*d.* per ton. Fuel can be procured on such terms that pig iron is manufactured in those districts at a price quite as low, if indeed at the present moment not lower than that at which metal of similar quality is produced on the banks of the Tees.

Excessive cost of iron in Great Britain.

I shall now endeavour to follow through their course those events which preceded and accompanied so remarkable a change in the world in the value of coal and iron in the years succeeding 1870.

The coal and pig iron production of the United Kingdom was, according to the Geological Survey, as follows :—

	Tons. Coal.	Tons. Pig Iron.
1870 - -	110,431,192	5,963,515
1871 - -	117,352,028	6,627,179
1872 - -	123,497,316	6,741,929
1873 - -	127,016,747	6,566,451
1874 - -	125,067,916	5,991,408
1875 - -	131,867,105	6,365,462

Increase in quantity of coal and pig iron in years 1870 and 1871.

Between the years 1870 and 1871 it will be observed that there was a very large increase in the quantity of coal and of pig iron. It might be difficult to account satisfactorily to what the extraordinary demand was due, nor is an explanation of necessity here of much importance.

Increased requirements equal to 6½ °/₀ for coal and 22 °/₀ in iron took place; but great as the latter was it did not perhaps very greatly exceed the powers of production so far as the year 1871 was concerned. If the consumption of iron, however, is to be regarded as an index of the activity of all other branches of commerce, it is clear that the additional output of coal bore no relation to that of iron. Equally did the demand for coal for foreign countries bear signs of an augmentation in industrial enterprise.

Export of coal and coke from Great Britain in 1868 and 1869. From 1870 to 1875.

In 1868 and 1869 the coal and coke exported from Great Britain amounted to 10¾ millions of tons for each of those years.

	Tons.
In 1870 it was - - - -	11,702,649
1871 - - - -	12,747,989
1872 - - - -	13,198,494
1873 - - - -	12,617,566
1874 - - - -	13,927,205
1875 - - - -	14,544,916

In pig iron an increased production of about 664,000 tons in 1871 enabled this country to keep pace with the additional demand on its resources, and prices remained stationary. The following year, however, with a still further rise in the make of about 110,000 tons, the supply was in deficit, and small as this shortcoming may have been it sufficed to cause a rapid rise in value, prices having reached 122*s.* 6*d.* in August. In 1873 the quotations for four months averaged 127*s.* 6*d.*, the average for the whole year being 115*s.* It is needless to point out the immense inducement to manufacturers under such circumstances to strain every effort to keep up their output; nevertheless, in the year in question the quantity made fell off to the extent of 175,000 tons as compared with the previous year.

Cause of diminution of production.

Now the cause of this diminution of production was chiefly, if not entirely, due to the difficulty of obtaining raw materials, and so pressed were the coal owners, that coke which in 1870 could be had for 12*s.* or 13*s.* per ton commanded at one period as high a price as 40*s.* to 42*s.* in 1873. British consumers, in consequence, had to outbid those in foreign countries, and accordingly our exports over sea suffered a diminution of 581,000 tons in the year in question. The effect of this demand at once made itself felt in the expenses of working both coal and ironstone, so that as compared with 1870 these had increased in the case of both from 60 to 70 °/₀. Labour at the blast furnaces rose about 50 °/₀ and the actual cost of pig iron was affected to the extent of fully one-third.

Cumberland and Lancashire Red ore districts.

In 1874 the average price of Cleveland pig receded to 67*s.* 6*d.* from 115*s.* in 1873; nevertheless, owing to labour difficulties, the cost of production rose 15 °/₀ on that of previous years. That which took place in Cleveland was happening all over the kingdom. A rapidly increasing demand for steel rails produced a corresponding effect upon the resources of the Cumberland and Lancashire

Red ore districts. The following are the quantities and values of the ores from these two counties according to the Geological Survey from 1870 to 1875:—

Quantities and values from 1870 to 1875.

	Tons.	Value.
1870 - - - -	2,093,241	£1,556,349
1871 - -	2,233,751	2,612,785
1872 - - - -	1,769,516	2,204,602
1873 - -	2,156,373	2,693,593
1874 - - - -	2,033,023	2,508,896
1875 - -	1,982,452	1,486,839

These figures prove that a quantity of ore worth in round numbers a million and a half sterling had its value raised in an incredibly short space of time to two and a half millions.

So far this is repetition of what took place in many of the mining regions of the United States. In their case, as in ours, the resources of the mines were taxed almost to their uttermost, and prices rose accordingly. Had the Bessemer works of Great Britain been left solely dependent on the Cumberland and Lancashire mines there is every reason for believing that prices of ore would have remained at the high figure reached in 1871, at all events until a number of the steel rail mills were closed. Foreign countries, however, were permitted by our legislation to relieve the wants of our steel makers, but no such succour was at the command of their American competitors; or, what is the same thing, had it been offered for their acceptance it would have been declined, except on terms which rendered the offer one of no value.

In the latter part of 1875 the price of Cleveland iron fell to 54*s.*, the average for the year being 60*s.*; but by this time a considerable economy had been effected in the cost of manufacture so that there was to the maker a margin for profit.

At the end of 1876 great troubles overtook the district and failures of serious magnitude occurred, and although wages in the coal and ironstone mines were again reduced, the present market value of pig iron at Middlesborough is probably below its average cost.

Increased cost of iron in America.

Violent as were the disturbances in the market value of British iron of all kinds, in the price of the commodities which entered into their manufacture, and in the cost of labour, events connected with the iron trade in the United States were not less remarkable.

Production of coal and pig iron in U. S. from 1870 to 1875.

According to tables which are given in the reports of the Iron and Steel Association the production of coal and pig iron in the United States since 1870 has been as follows:—

	Coal. Tons.	Pig iron. Tons.	Estimated Increase of Capacity.	
1870	36,622,131	1,865,000	20 furnaces	193,000 tons
1871	37,861,415	1,911,608	16 „	171,200
1872	42,749,243	2,854,558	53 „	662,400
1873	45,413,400	2,868,278	54 „	515,500
1874	46,500,000	2,689,413	31 „	278,900
1875 about	46,000,000	2,266,581	29 „	301,400
			203	2,122,400

The last column is an estimate I have made by taking out from the Directory of the iron works of the United States the new furnaces, and their capacities, built in each year. If the figures are correct, it follows that there must have always been a large number of furnaces lying idle.

	Tons.
The present annual producing power as given by the Iron and Steel Association is - - - -	5,439,230
From this the make of 203 furnaces erected since 1870 must be deducted, equal to smelting - - - -	2,122,400
Leaving the capacity at the beginning of 1870 -	3,316,830
But in that year the production was only - -	1,865,000
Leaving to be accounted for - - - -	1,451,830

Of this large quantity a portion no doubt would be due to furnaces in existence but not in blast in 1870; but surely this can only account for a portion of the difference, for it is improbable that speculators would proceed to add so largely to the smelting power of the country with nearly half the then existing furnaces in a state of inactivity. No doubt it might be that inferiority of situation led to this, but then the explanation means that they should not be admitted into the account.

The very ample pig iron statistics given in the Report of the Iron and Steel Association refer to that made with anthracite, and as this quality of metal constitutes one half of the entire make it can be most readily employed as a means of illustrating the object of the present stage of our inquiry.

Great increase in cost of labour and materials during the war.

During the civil war, which commenced in 1861 and continued till 1865, there was a great increase of cost both in labour and materials in general. I have, therefore, selected five years of tranquillity ending with 1860 as illustrating a former condition of the anthracite iron trade.

——	1856.	1857.	1858.	1859.	1860.
	Tons.	Tons.	Tons.	Tons.	Tons.
Total anthracite coal raised -	6,927,550	6,644,941	6,839,369	7,808,255	8,513,123
Do. Do. pig made -	443,113	390,385	361,430	471,745	519,211
Price of pig in Philadelphia* - - per ton	113*s.* 0*d.*	110*s.*	92*s.* 8*d.*	97*s.* 6*d.*	94*s.* 9*d.*
	Cost per Ton of Pig, exclusive of Interest.				
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
For Coal - - - - - -	0 16 3	0 16 3	0 16 11	0 13 7	0 14 6
Ore - - - - - -	1 11 3	1 12 3	1 11 11	1 9 6	1 11 0
Limestone - - - - -	0 3 10	0 4 9	0 4 11	0 4 9	0 5 0
Labour - - - - - -	0 11 10	0 9 7	0 8 9	0 7 7	0 7 9
Contingencies - - - -	0 12 0	0 9 0	0 11 2	0 11 9	0 11 9
At the works - -	3 15 2	3 11 10	3 13 8	3 7 2	3 10 0

* Gold dollar taken at 4*s.* 2*d.*

The following shows the costs for the last five years:—

——	1871.	1872.	1873.	1874.	1875.
	Tons.	Tons.	Tons.	Tons.	Tons.
Anthracite raised - - -	15,113,407	19,026,125	19,585,178	18,980,726	19,611,334
Do. pig made - - -	965,608	1,369,812	1,312,754	1,202,144	908,046
Price of iron in Philadelphia -	133*s.* 9*d.*	184*s.* 3*d.*	161*s.* 3*d.*	114*s.*	96*s.* 3*d.*
	Cost per Ton of Pig, exclusive of Interest.*				
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
For Coal - - - - - -	1 12 3	1 7 5	1 8 1	1 8 10	1 7 2
Ore - - - - - -	2 7 8	2 11 4	2 16 0	2 6 6	2 0 9
Limestone - - - - -	0 7 9	0 7 8	0 7 5	0 6 1	0 3 10
Labour - - - - -	0 13 4	0 17 8	0 19 3	0 13 0	0 9 9
Contingencies - - -	0 10 4	0 11 0	0 11 3	0 8 1	0 7 0
	5 11 4	5 15 1	6 2 0	5 2 6	4 8 6

* Currency dollar taken at 3*s.* 9½*d.*

We have here as in Great Britain a rapid rise in the cost of the iron as prices advanced, but it will be observed that as the metal declined in value there is by no means a corresponding reduction in the cost of materials as is noticeable in Great Britain.

Profit on manufacture of pig iron in America.

The immediate effect of a rise in the price of pig iron from 94*s.* 9*d.* to 184*s.* 3*d.* within two years must of course have been attended with enormous

profits to the pig iron manufacturers, inasmuch in the former year (1860) after deducting carriage to market there must have been a margin of about 20*s.* per ton between that and selling prices; indeed according to the figures given in the Report of the Iron and Steel Association the balance in favour of the maker was above three pounds per ton for the year 1872.

The accounts given me by managing partners of certain establishments amply confirmed this, and might have been deemed fabulous had the figures issued by the Iron and Steel Association itself not gone to prove that in one year the profit accruing from the manufacture of pig iron was more than equivalent to the cost of the furnace which made it, and yet this is an industry which required a protective tariff for its very existence. What is true of pig iron is perhaps equally so with malleable iron and steel; the returns for the outlay involved in their construction were far beyond those which a farmer or cotton grower ought to have been called upon to pay who had to sell his produce in the markets of the world.

Reaction.

They however who were led to embark their capital in blast furnaces and rolling mills have had to pay somewhat dearly for the advantages reaped during the years of high prosperity. It will be remarked that comparing the years 1857 and 1872 pig iron rose 74*s.* 3*d.* in value, but of this 43*s.* 3*d.* was absorbed in increased cost; but when we look to the years 1860 and 1875 we find that iron was in 1875 selling 1*s.* 6*d.* above the price of 1860, and at the same time the cost of production was 18*s.* 6*d.* more in 1875 than in 1860.

I would ask permission to examine a little into the cause of this; and, firstly, as regards the increase in the cost of coal for each ton of pig iron.

A virtual monopoly acquired by six large companies who are also carriers.

Of the 46 millions of tons of coal worked in the United States about 21 millions are anthracite, and yet the market of this last named large quantity is practically in the hands of six large companies who represent 80 to 85 °/₀ of the entire output. They not only possess, by virtue of this preponderance of influence, a controlling power which overrides that of all anthracite coal owners outside their number, but being carrying companies as well, all liberty of action on the part of those who constitute the remaining 15 to 20 per cent. is annihilated.

It is no secret that under such a system the profits of coal property have been very great, so much so as to induce at least one of the railway companies to embark, perhaps, to an imprudent extent in the purchase of coal lands. At all events from whatever cause, the company in question, with a magnificent property, is in a position of serious financial embarrassment.

Many years ago a combination was entered into by the coal owners of the North of England, not so much for securing high profits as to protect themselves against actual loss. Attempts were made to fix the market price by limiting the production. It all ended in failure, and such did I venture to predict would be the destiny of the anthracite coal combination of Pennsylvania.* In an American coal trade publication of January 1877 it is stated that the loss of the company in question is "not alone due to the depression "of business, but was caused by the unfair working of the association of coal "producing and coal transporting companies by which the company in the "months of June, July, and August was practically deprived of its proper "share of coal tonnage, and was for the time unable to protect itself."

Danger of artificial restrictions.

All this experience tends to show the extreme danger which accompanies all artificial restrictions when applied to commercial transactions; they may sound well in theory, in practice they are abortive failures.

As regards the conduct of the coal owners towards the smelters it might be intelligible enough that with a rise of more than three pounds ten shillings in pig iron there should be such a demand for coal as to have justified the coal owner in putting up the price of his commodity, so that the cost of it on a ton of iron was raised from 15*s.* 10*d.* to 27*s.* 5*d.* per ton. It is perfectly true that the increase in the make of pig iron between the two years in question, 1857 and 1872, was 250 °/₀, but the output of coal was augmented from about 6½ to 19 millions of tons, or nearly 300 °/₀ in the same periods. That which, however, is not so intelligible is that with a falling off in the production of pig iron of fully 33 °/₀ in 1875 as compared with 1872, accom-

* Notes of a Visit to the Coal and Iron Mines and Ironworks of the United States, 1874.

panied by a still further *increased* production of coal by 600,000 tons, the iron master, selling his produce at 96*s*. 3*d*. instead of 184*s*. 3*d*., should have to pay the same for his coal in both cases.

There is, it ought to be observed, something which requires explanation in the treatment which the furnace proprietors have received at the hands of the coal owners, inasmuch as from the figures in the Report, and which constitute the basis of the present calculation, the selling price of anthracite coal in Philadelphia was not materially affected during the ten years under review. The average during each five years being nearly the same :

1856.	1857.	1858.	1859.	1860.		Average.
17*s*. 1*d*.	16*s*. 1*d*.	14*s*. 3*d*.	13*s*. 8*d*.	14*s*. 2*d*.	=	15*s*. 0*d*.
1871.	**1872.**	**1873.**	**1874.**	**1875.**		
16*s*. 10*d*.	14*s*. 0*d*.	16*s*. 1*d*.	17*s*. 2*d*.	16*s*. 6*d*.	=	16*s*. 1*d*.

It must not, however, be supposed that the difference of the cost of coal to the iron manufacturer, being that between 15*s*. 10*d*. and 27*s*. 5*d*., all went into the pockets of the colliery owner. The excessive demand for labour led to extravagant demands on the part of the men. Serious disturbances and strikes lasting for several months arose, and ultimately a scale of wages was agreed on which brought to the hewers in the anthracite pits close on two pounds per day. At the present moment the daily earnings are about half this amount, but the pits, as has been remarked, are only working half time.

General rates of wages in America.

The present being a favourable opportunity of making a few observations in the rate of wages generally in the United States, I will avail myself of it in order to mention some other instance besides those of the anthracite miners which appeared to me disproportionately high.

Agricultural labourers as a standard of comparison.

Taking agricultural labourers as a standard of comparison, these have in common with all classes received a substantial increase to their pay in late years. In Missouri 3*s*. 6*d*. a day and 3*s*. 9*d*. in North Carolina and Pennsylvania were spoken of as the wages for this class of men, and during harvest time, as with us, these terms are largely added to. Against this has to be placed the fact that agricultural produce since the establishment of railways has advanced in far more than a corresponding ratio. Compared with Great Britain among the men who receive in America what may be regarded as a disproportionate amount of pay are those known as ordinary labourers at the ironworks and mines. Men who a few years ago earned 2*s*. 10*d*. a day now insist, at a period of great depression, on having 4*s*. 8*d*. to 5*s*. 6*d*., and even more than this. For a similar class of workmen about ironworks in the north of England about 30 °/₀ less than these prices was being paid. It would appear as if the stimulus given by the rapid extension of industries of various kinds in the United States had enabled men connected with the building trades to enforce demands never heard of in England; thus, at Ironton the average day's wages for bricklayers in 1874 was 18*s*. 10½*d*., and a strike took place when the master builders refused to advance the rate to 20*s*. 9*d*.

Average wages in U. S. and Great Britain.

The following is a list of daily wages showing the average of many inquiries at the end of 1874.

	Different parts of United States.			North of England.
	Highest.	Lowest.	Average of all.	Good Men.
Carpenters -	12*s*. 3*d*.	5*s*. 7*d*.	9*s*. 0*d*.	5*s*. 0*d*.
Smiths - -	13*s*. 2*d*.	6*s*. 2*d*,	9*s*. 5*d*.	6*s*. 0*d*.
Bricklayers -	18*s*. 10*d*.	7*s*. 6*d*.	12*s*. 3*d*.	5*s*. 6*d*.
Machinists -	11*s*. 3*d*.	7*s*. 6*d*.	8*s*. 3*d*.	5*s*. 10*d*.
Engine men -	-	-	6*s*. 6*d*.	5*s*. 6*d*.

What appears somewhat extraordinary is that the men of the capacity of machinists who are engaged in preparing and putting together delicate parts of machinery should be less well paid than men employed in much rougher work. The highly disproportionate rate earned in some cases by bricklayers was accounted for by their loss of time during the long and severe winters. In ironworks where men of this stamp have constant employment in repairs, protected from the weather, 8*s*. or 9*s*. was about the prevailing scale.

The rates paid for puddling iron, as already stated, varied greatly in different localities.

The lowest rate given me in 1874 was about 17*s*. 0*d*. per ton;
a very common one was - - 22*s*. 7*d*. ,,
and the highest I heard of was - 24*s*. 6*d*. ,,
the average of all my returns being - 20*s*. 7*d*. ,,

At the period in question the Middlesborough rate scarcely exceeded one half of the average of the above, it being 10*s*. 9*d*. per ton, at which the head man would earn about 8*s*. and the under-hand 4*s*. per diem.

The malleable iron manufacturers in Pittsburg assured me in July 1876 that they could not live with the present price of pig iron and the high wages bequeathed as a legacy from better times when puddling reached 30*s*. per ton. The head rollers I was informed were earning from 30*s*. to 38*s*. per day, and the mill furnace-men 15*s*. At the same time the prices paid at Middlesborough were such that 21*s*. 8*d*. for the former and 7*s*. 3*d*. for the latter would represent the current rates. At the date of my second visit the puddlers were on strike for an advance on the price they had been receiving for some time past, and they ultimately succeeded in making good their demand.

Intemperance.

In the matter of intemperance it is extremely difficult for a stranger to draw any comparison which discloses accurately the real state of the case. All I can say is, that the complaints of the employers in America were quite as numerous and quite as severe as those I am in the habit of hearing and experiencing in this country. In one case, that of the railway shops at Altoona, the plan of forbidding the sale of intoxicating liquors in the town had been tried with such unsatisfactory results, that on the petition of the railway company the old order of things was re-established.

Disinclination of native Americans to severe manual labour.

According to my information the native born Americans evince more than a disinclination to apply themselves to the severe labour of the mine and the iron works, and in consequence fresh hands are almost exclusively recruited from immigrants. What struck me upon many occasions was the number of small shopkeepers in places of comparative unimportance, indicative, it might be, of a preference for the greater ease of the employment, as compared with severe manual labour.

Effect of land purchases on wages.

The opinion is not uncommon in America, that so long as land can be acquired at a cheap rate, wages will continue far above the price which it obtains in a country differently circumstanced. To what extent there may be truth in this opinion it is difficult for a stranger to decide; hitherto it looks as if the extraordinary strain imposed on the labour market was quite sufficient to account for any difference which exists between the new and old worlds.

Increased cost of the ore.

Returning now to a consideration of the circumstances which have operated so seriously in raising the cost of making pig iron in the United States, I will pass on from the coal to the ore required in the process.

So far as the fuel is concerned, I have given reasons which tend to show that those artificial restrictions wielded by half a dozen great companies have had something to do in doubling the cost for coal on a ton of iron. These observations, however, are almost exclusively applicable to the furnaces dependent on the anthracite region for their supplies. In Pittsburg and in localities furnished by the bituminous coal fields the difficulty referred to has been much less severely felt.

The tendency of some remarks in a previous page was to show that the actual producing powers of pig iron in the United States are probably overstated in the figures made use of by the Iron and Steel Association, and hence that somewhere nearer four and a quarter than five and a half millions would represent the real annual efficiency of the smelting works of North America. Taking it, however, at the lesser figure, we have the output making a bound of 125 °/₀ in five years.

The coal required for this addition, although important, did not constitute a very serious increase on the 36 or 37 millions of tons raised in the United States, whereas every fresh ton of iron represented a corresponding rateable addition to the output of ore; in other words, the iron mines were called upon suddenly to furnish an increase of one and a quarter times their accustomed quantity.

Sources of ore.

Reverting to the list given of the sources of ore, it will be seen how impossible this was of accomplishment. Lake Superior of all present modes of

supply is the most important. Its produce in 1870 amounted to a little over 856,000 tons, and the following year there was, from some cause, an actual diminution of 43,000 tons. In 1872, according to Swineford's History of the Mineral Resources of the locality, no less than seven new mines were opened, in the hope of increasing the quantity, and abandoned after adding but little to the general fund. Seven during 1873, and five in 1874 shared the same fate. By dint of great exertion in 1873, 30 mines or thereabouts managed to raise the output to 1,167,000 tons, which is the largest annual weight hitherto attained.

The clay ironstone is obtained in seams of too small dimensions to admit of a speedy development at all commensurate with the new requirements of the trade, and the brown and red fossiliferous ores, although plentiful in certain localities, are remote from the great markets, and were moreover found in States too much depressed by the recent civil war to afford any relief.

New Jersey. Iron Mountain district. Port Henry mines, Lake Champlain. Cornwall Banks.

The want of volume in the veins of New Jersey, and the moderate area occupied by the deposit in the Iron Mountain district of Missouri, equally shut out the possibility of any large and sudden increase of quantity from these quarters. At the Port Henry mines at Lake Champlain, the ore occurs in immense quantities; but this in the district generally is an exceptional state of things, so that probably 500,000 tons is as much as could be hoped for from the veins in that neighbourhood. Cornwall Banks no doubt possesses large resources, but hitherto the policy of its owners, I was informed, has rather been to limit the quantity worked, and thus command a higher price for what they sold.

Adopting the four and a quarter millions of pig as the probable annual capacity of the country, it is not surprising that under the circumstances just described, it was found impossible to supply the new works with the additional demand for ore for making 2,122,400 tons of iron,' for of it one half was as much as could at any one time be furnished. It seems pretty sure that had the whole of the new furnaces been started and kept going, a market could not have been found for their iron; not less certain, however, would be the effect on the minds of the mine owners on receiving in the aggregate, applications for nearly twice as much ore as they had been in the habit of raising. Indeed the already overtaxed resources of these establishments was apparent in the fact that between 1860 and 1870 iron ore had risen 50 °/₀ in value. Nevertheless speculators were sufficiently numerous to venture on the erection of works for which there was no ore, and for the produce of a large proportion of which there was no market. No doubt in these wild dreams of unlimited demand they were encouraged by the promise that American markets should, so far as legislature could promise, be reserved for American furnaces, and the result has been that the owners of coal and iron mines are obtaining together a profit of nearly 30*s.* a ton on pig iron, while the unfortunate iron smelter is sadly perplexed to make the two ends meet.

Wages in Great Britain and in United States.

In respect to the labouring classes, on whose behalf so much is said in the Report of the Iron Association, it will be seen that on the whole, the men engaged in mining and smelting were not much better paid than were similar classes in Great Britain. To this there is the notable exception of the anthracite coal hewers with their 18*s.* 10*d.* a day; but then they were working half time, so that at the end of the month they had no more money to receive than a man working for half this wage in the bituminous coal pits of the West and the South.

General Conclusions.

The Coal Association of the anthracite district which has acted prejudicially to the present interests of the iron trade, as well as to the future interests of its own body, has broken down. The fuel will probably now in consequence be delivered to the blast furnaces untrammeled by any action which interferes with its natural price. Iron ore stands, however, for the moment on a different footing. Far more furnaces have been suddenly built than there are the means of supplying from existing mines; and the price, as determined by the actual demand, is more than the iron masters can afford to pay. The mine owners, however, are no more responsible for this than they are for the fact that the selling price of the excessive production of pig iron is below that of its cost of production.

Of course it may be alleged that free trade does not secure immunity from such a crisis as that which is weighing down the iron trade of the United

States. That is so; unforeseen increases of demand such as happened in 1872 raised prices to an unnatural pitch in this country and in Europe generally, and we are suffering from the consequences. This rise, however, so to speak was from a natural cause, but what is sought for among other advantages of an unrestricted commerce is to avoid undue stimulus to any one interest, for by it in all probability that trade which is made the object of undue nursing will suffer in the long run.

Railroads in the United States were considered, and rightly so, as a national necessity. Congress by large grants of land promoted their construction, and American rail makers at the time no doubt regarded this fostering care with satisfaction, although the Iron and Steel Association now seeks to make its own Government responsible by this very line of action for the present panic. This protection it now condemns, and yet inconsistently enough demands an addition "to the duties on foreign manufactures," which would have a tendency to perpetuate the same evils on the iron manufacturers as those which flowed from "the building of railways which were not needed," and to the equally needless building of furnaces and rolling mills.

Railroads in U. S. a national necessity.

The malleable iron works it is true are exempt from some of the troubles which beset the blast furnaces, but they have others which weigh heavily upon them. Many of them were receiving pig iron charged with a profit to the coal and ore mines of nearly 30*s*. a ton, which would be equivalent to 40*s*. on bar iron. The iron ore used in the repair of the puddling furnaces had also to be obtained at a great increase of price, and a very serious difficulty they have to contend against is the high rate of wages. The labour of the miner is not of that character to prevent a strong man of ordinary intelligence acquiring all the skill necessary in its pursuit in a few months. About blast furnaces there are always in the company of the chief workman other men who, though perhaps less skilful than the furnace keeper, possess sufficient knowledge to enable them on a case of emergency to take his place. In the puddling forge and rolling mills this state of things does not obtain, at all events not to the same extent. Hence this difficulty of procuring at a short notice any considerable accession of power, from which arose the necessity of tempting men out from England by the prospect of higher wages than were paid in that country. From the position thus taken up by the malleable iron manufacturers themselves, they have not succeeded in retreating in a degree at all commensurate with the altered state of trade.

The prospect of large profits to be derived from iron making not only induced those already engaged in it to add to their power of production, but companies, consisting of gentlemen without any special knowledge of the art or any general knowledge of the resources of other districts, promoted the erection of new works.

Speculative companies.

The existence of a bed of ironstone, however poor or however inaccessible, sufficed to awaken the hopes of sanguine speculators who in some instances were supported by promises of gifts of land or indeed of money from the community. A company was formed to erect blast furnaces were no iron work ever ought to have existed; able enough no doubt to live in times of inflated prices, but powerless to meet competition even in periods of reasonable profits in more favoured localities.

Great Britain cannot boast of any immunity from reckless speculation in iron enterprises; for probably more money has been wasted in connection with this branch of our country's industry than with any other. The history of our progress, however, as iron manufacturers, presents no parallel to that attempted within the compass of half a dozen years by the United States of America.

In 1870, as we have seen, their production of pig iron was under 2,000,000 tons, in 1873 it was nearly one half more, and by the end of 1875 the power of the furnaces in existence as claimed by the iron masters themselves is almost exactly three times the quantity it was in the first-named of these few years, the increase being equal to nearly 25 °/₀ on the entire make of the world.

Production, 1870 and 1873.

It was expected that immediate employment would fall to the share of the new furnaces by the exclusion of the million tons formerly supplied from Great Britain, and so far as imports are concerned the hope has all but been fulfilled. American consumption, however, has fallen off to the extent of one half the quantity formerly imported, more than half of all the furnaces are

idle, and a great number of those in blast are losing money, with pig iron considerably dearer than it was with a large importation of British iron to meet it in the market.

It is often publicly stated, that the natural advantages possessed by the United States are such as will enable her iron manufacturers to become exporters, and meet Great Britain in all the markets of the world. It is needless to dwell on the inconsistency of a nation entertaining such hopes, and at the same time demanding a protective tariff to an industry working on its own soil, against the importation of British iron costing a pound or thirty shillings to reach its shores.

I will not pretend that markets may not be opened out for American iron in countries immediately contiguous to the United States, but with the figures before us, and the position of the present known sources of supply of the raw materials there, it is in my opinion a mere delusion to expect that the Continent of Europe, much less Great Britain, will ever be purchasers of the metal in any of its unmanufactured forms produced in the interior of America.

Differences in the information I received will account for any small inconsistencies which may be detected in my calculations; I venture, however, to hope that none will be found to disprove the general correctness of the views I have endeavoured to explain.

Stated shortly these views are as follows:

1st. That the powers of iron production between the years 1870 and 1875 were increased in the United States far beyond any possible requirements of the country:

2nd. That the high prices which led to this, permitted and induced the manufacturers to accede to demands from certain sections of the workmen which are now acting adversely to the true interests of the trade:

3rd. That the same causes reäcting on the value of the raw materials along with the increased value of labour, as above stated, have unduly added to the cost of iron:

4th. That the interference with the laws which regulate the prices of commodities has in the case of anthracite coal added to the difficulties of the iron smelters; and the sudden demand made on mines incapable of meeting it has increased those difficulties by an unhealthy addition to the selling price of iron ore:

5th. That the protective duties levied on foreign iron entering the United States by raising the price there, are chargeable with a portion of the mischief:

6th. That the natural resources of the United States of America are such as to render any protective tariff on iron unnecessary, which tariff moreover is an injustice to other branches of industry.

I. Lowthian Bell.

Rounton Grange, Northallerton,
January 1877.

Mr. R. H. SODEN SMITH, M.A., F.S.A.

CERAMIC AND GLASS WARES.

REPORT on CERAMIC AND GLASS WARES shown at the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By R. H. SODEN SMITH, Esq., M.A., F.S.A., Keeper of the National Art Library, South Kensington Museum.

To HER MAJESTY'S COMMISSIONERS for the INTERNATIONAL CENTENNIAL EXHIBITION.

GENTLEMEN,

IN accordance with the request conveyed in the letter which I had the honour to receive of the date 29th June 1876, I beg to present, for the information of His Grace the Lord President of the Council, the following report on Group II. (2) (*Ceramic and Glass Wares*) in the International Exhibition at Philadelphia. Group II.

The following gentlemen acted as judges in this group, of which I was chairman:— Judges.

General Gilmour	United States.
General Hector Tyndale	United States.
Professor Cox	United States.
Professor Wurtz	United States.
Arthur Beckwith, Secretary	United States.
Dr. Nordenskiold	Sweden.
Professor De Bussy	France.
Dr. Seelhorst	Germany.
Notomi Kaijiro	Japan.

The extent and variety of the collections included in Group II. were so great, that in order to compress my observations within reasonable limits I have—1st, condensed into some preliminary remarks the matters which bear on the exhibition of ceramic wares, &c. as a whole. Scope of Report.

2nd. I have omitted historical details respecting the several factories, excepting those in the United States, such details having been accumulated in many previous reports, and being accessible in various published works.

3rd. I have noted under the heading of each country such objects only as were most important or attractive, not attempting in the space at my command to characterise each competitor's display; the published awards as recommended by my colleagues and myself being a sufficient record of the success of individual exhibitors.

It may be convenient to indicate broadly some of the characteristics of the exhibition of ceramic and glass wares as a whole, before giving the necessary details respecting the collections exhibited by each country taking part in this international competition. Preliminary remarks.

The display was extensive and important, and the field covered a very wide one; the number of exhibitors was 592; of these 393 were external to the United States, and 199 were from the States. Number of exhibitors.

Some of the exhibitors from distant countries brought collections of great extent in the number of pieces, and of importance as regarded the size and value of individual specimens.

The objects shown included porcelain of hard and soft body, biscuit, Parian, porcelain trimmings, chemical porcelain; stonewares, as well unglazed as with salt and lead glazes and with various coloured glazes—pottery of hard body, stone china, "granite" ware, and the softer "C.C." or cream-coloured wares; fine faïence of solid body and soft faïence of a great variety of materials and glazes; majolica and Palissy wares; modelled terra-cotta in statuettes, &c.; moulded and pressed terra-cotta for architectural purposes; tiles of every variety—encaustic, glazed, enamelled, painted, printed—of the hardest body, and of the softness of ordinary faïence—for pavement, wall construction, and decoration, ceiling, and roofing; mosaics for floor and wall decoration; also bricks, drain-tiles, fire-clay goods, crucibles, pots, &c. Varieties of manufacture represented. Ceramic wares of every description.

In addition to these objects were exhibited cements, with specimens of crude materials, artificial stones, plasters, brick and tile-making machines; also samples of various clays and other bodes used in the manufacture of porcelain and pottery. Cements. Raw materials and machinery.

Glass.

Glass in almost every development of its manufacture was shown, and from most of the countries taking part in the Exhibition.

Such being the range of the objects composing the collections classed under Group II. it is obvious that much space was needed for their display, and that they were likely to spread through several of the buildings occupying the Centennial grounds. They were disposed as follows:

Disposition of objects exhibited.

In the main building was almost the whole of the porcelain, faïence and other earthenware, terra-cotta, and tiles; also the most considerable part of the chemical and other stoneware, and a large share of the drain and sewer pipes; some of the fire-clay goods and bricks; also almost the whole of the glass.

Memorial Hall. Signor Castellani. "America."

The Memorial Hall contained some prominent specimens of porcelain, as well as the remarkable collection of early Italian majolica exhibited by Signor Castellani; also the colossal group in terra-cotta representing "America," being a full-sized reproduction of one of the corner pieces of sculpture in marble which form part of the Albert Memorial in Hyde Park.

Women's Pavalion.

A few exhibited objects in porcelain and faïence appeared in outlying buildings, as the Women's Pavilion, &c., but these were of minor consequence.

The bulk of the fire-bricks, as well as the materials for pottery and glass, and the machinery, and models connected with the group, were shown in buildings apart from the main structure.

European porcelain not fully represented.

In respect of porcelain, Europe was not represented at her best. The great French national establishment at Sèvres sent no special collection, and its work was only to be seen in certain examples exhibited as objects of decorative art in the Memorial building; neither was the collection from Germany such as might have been expected; some of the chief English manufacturers also did not enter into competition.

Wide range of the collection.

On the other hand, the range of the Exhibition was very wide and the variety great, and thus the general position of the manufacture in Europe could be fairly judged; the results of the efforts of the last twenty years could be noted; the higher aim of the art recognised, its wider scope, the more varied character of the products, and especially its improvement in the principles of decoration.

Stoneware and faïence.

In stoneware and faïence, as will presently be noted in some detail, the Exhibition was strong, and the advance of the art in the last few years very marked. A wide field of enterprise has been opened in this direction, and will yet be much extended. The manufacture of terra-cotta also has made important progress and has still much more to do.

Chinese and Japanese porcelain, &c.

The exhibition of Oriental, that is Chinese and Japanese porcelain and pottery, was on a large scale, and full of interest.

The Japanese collection especially was of first-rate value, and may be acknowledged as the most important contribution to the Ceramic Department brought together by any one country. It will not therefore be out of place to dwell for a moment on the nature of this remarkable display of attractive and often gorgeous products of the potter's art.

Bad effect of modern innovations.

It must be premised that the Oriental art in porcelain, even when the specimens are freshly made, is in fact ancient art. Whatever innovation has been introduced has proved disadvantageous, and just so much as the artists have adhered to the old paths, success seems to wait upon them; this is indeed not encouraging, but so true does it seem, that the Japanese, despite their wonderful desire for progress and their power of assimilating western notions, are themselves aware that their art deteriorates when sought to be "improved" by European influence.

Causes of deterioration.

Another cause of deterioration, however, has been unfavourably at work—the desire to supply rapidly a foreign and indiscriminating market; and thus inferior productions, carelessly and hastily made, have in large quantities been exported.

Influence of tradition on art.

To purely western notions the peculiar influence of tradition on art is not easy to realize: the conception of subject, the method of design, the laws of ornament, are in great measure fixed not less than the processes by which the work to be done is carried out. Thus in India the arts of the goldsmith, to mention no others, are traditional, and in China those of the potter. Until recently this has been the case in Japan also, but owing to the superior energy of the race, not in so marked a degree. Happily, the efforts made to do justice to their country's art on the occasion of the present Exhibition seem to have specially drawn the attention of native artists to the danger of abandoning the ancient traditions of their country.

The seats of manufacture more notably represented are spread pretty widely through the empire, and most of them will be found specified in the subsequent report. With the names of some the European markets are already familiar. Seats of manufacture in Japan.

All have hitherto had their distinctive characteristics, not so much of material as of style, and seem to be influenced by peculiar traditions, great pains having been taken in some instances to keep the special processes secret; but of late years close imitations of some of the more popular and successful wares have been produced in factories distant from the original localities. The varieties of pottery both hard and soft known as Satsuma and Kiyoto wares were represented by a very large and varied collection, the work of many producers: the soft creamy coloured ground, its delicacy of tone enhanced by the reticulation of minute cracks which pervade the glaze, forms a most effective surface on which to scatter the profusion of flowers, birds, insects, &c., in which the ornamentalist delights. These are conceived with a singular power of seizing the salient or most expressive features of each object, and touched with a lightness of hand and felicitous freedom that can scarcely be surpassed; the balance of parts also is preserved in the midst of quaintness of idea and an almost extravagance of freedom. In all the finer pieces the colours, not generally of a high key, are yet sufficiently brilliant and always harmonious. Where the human figure occurs, expression and colour alone seem aimed at, and the grotesque manner of delineating the contour and the limbs excites surprise when compared with the truth as well as vigour often notable in the representations of birds, certain quadrupeds, reptiles, and insects. Satsuma and Kiyoto wares. Decoration of flowers, &c. Treatment of the figure.

Besides the lessons to be learned from the ornamentation of these attractive wares, their forms and the skill of the potters deserve both recognition and study; the moulding is at times of surprising cleanness and ingenuity, and the *tours de force*, so to speak, in pottery are very remarkable; as for example a pair of large cylindrical vases surrounded by a complete case of openwork of oviform outline, even and true in execution. Skill in earthenware pottery.

Some of the stone-wares are of dense texture, and are decorated in a bold, free, and effective manner, the colours being usually in what is known as enamel painting, somewhat solidly laid on, and slightly relieved from the surface. Stoneware.

Among the pieces exhibited were examples of imitation of ancient works, especially of Satsuma ware, so ingenious and curiously antiquated in appearance as to deceive a practised eye. Imitations of ancient works.

Of the porcelain some of the specimens were, as regards the technicalities of their manufacture, among the most remarkable efforts of the art ever shown. A pair of vases 8 feet high, formed in two portions, were perfectly potted and gorgeously decorated; another vase, about 6 feet high, in blue and white porcelain, was a splendid example of skill and also of effective decoration. The building up of these great pieces is considered in Japan a very difficult feat, and the manufacture of the above-mentioned pair of vases was specially undertaken for the Exhibition. Another pair, described as being superior to these, and also made for the Exhibition, had not arrived at the period of the writer's visit. Evidences of technical skill.

To European and American potters are perhaps still more remarkable the large flat slabs of decorated porcelain exhibited. One of these, nearly 6 feet in diameter, was a wonderful example of manufacture in hard paste; the texture fine, the surface level, the glaze even. This splendid piece was also a work of art from the beauty and boldness of its decoration of flowers conventionally treated in blue on its white ground. It is stated by Japanese writers that slabs very much larger than this, as much as 10 ft. in diameter, have been successfully potted at the factory. Slabs in hard porcelain.

A pair of screens formed of slabs of thick porcelain, about 3 feet by 2 feet 6, were remarkable, not alone for their effective character as objects of ornament, their ground colour being a fine deep blue, with sprays of bamboo in white, left out sharp and clean, but also for the dexterity of their manufacture. The means by which they were supported in the oven were skilfully concealed, both sides of the slab being free from any trace of spurs or other methods of sustaining the large and weighty mass during the process of baking. The traces of such support may have been removed, and a glaze fusible at a comparatively low temperature used to conceal the marks of the rests. Skill in concealing method of baking.

Porcelain screens.

In any case these large slabs are finished on both surfaces so as to be suitable for use as ornamental screens; the framing of wood shows both sides artistically decorated, although by different processes. Other slabs of porcelain used as table-tops, and remarkable for their size, have been propped in the ovens by ordinary methods.

Skill in moulding.

It is not alone in unusual size of pieces that the skill of Japanese potters is shown, but also in various examples of the utmost dexterity in moulding, evenness of line, and accuracy of contour in difficult and complicated forms. The outlines and motives of some of the works have, no doubt, to western eyes, a character which is occasionally bizarre, at times almost grotesque; nevertheless the sense of proportion is satisfied, and the fitness and frequent splendour of the decoration lent peculiar attractiveness to the collection.

Blue and white china.

The display of blue and white china alone would have given the Japanese Exhibition a foremost place. The painting in blue underneath the glaze, with which these articles are for the most part decorated, is stated to be prepared from native ore containing cobalt, and for the finer quality, ore obtained from China. The skill and boldness of the decorative designs are often most admirable, showing a complete mastery of the ideas to be carried out, a fixed and clear appreciation of the conventional treatment appropriate to the material and position, and an almost unrivalled dexterity and certainty of touch. The delineations of certain animals and birds have perhaps never been surpassed in their fitness for decorative purposes. A Japanese artist learns in the school kept by nature, he studies with the most minute and painstaking observation; having done so he is no copyist, the images are the possession of his mind and imagination, and are produced as suits the object to be enriched in obedience to laws of decoration which no mere copying from nature ever will teach.

Admirable character of decorative designs.

Laws of Japanese decoration.

Kiyoto ware of Z. Yeiraku.

A richly ornamented ware produced in Kiyoto by Z. Yeiraku is capable at its best of furnishing examples of decoration which are very striking and sometimes splendid; the ground is painted all over with a fine red produced from oxide of iron, a colour first introduced into Japan about two generations ago by an artist potter whose name it bears. The art of making and using this red colour skilfully still remains in the family of its inventor or introducer; but the work of the present proprietor is not considered equal to that of his ancestor. On this gorgeous ground tint the most varied and complex designs, often mythological, are applied in gold; the effect is wonderfully rich. In the inferior pieces, however, and in the imitations of this decoration, the gold is over-burnished, and the excessive glitter mars the artistic keeping of the whole. In some of these last the deteriorating influence of second-rate European taste is unfortunately apparent; objects are produced mainly for exportation, and it is evident that the shrewd manufacturers understand the bad taste and ignorance of art they have to supply from the fact that such overwrought gilding is especially singled out for commendation by a writer of a series of articles in an American periodical. In the same papers the European imitations of oriental porcelain, in which the less commendable characteristics of the models are always faithfully reproduced and the finer qualities missed, are preferred to the originals. The Philadelphia Exhibition will do much to alter such views of art.

Chinese porcelain.

The Chinese collections of porcelain and pottery were very extensive, much more so in fact than could be fitly displayed in the allotted space.

Traditional skill.

Among the specimens were many that gave evidence of the traditional skill of the makers preserved through many generations; the body and glaze being excellent and the colours individually fine and pure; the potting dexterous and workmanlike. But the art in comparison with that of past time has deteriorated, it appears to live upon a decaying tradition; or where novelty is attempted there seems, as has been observed in the case of some recent Japanese productions also, in the ungraceful forms and crude colouring of the works a manifest effort to supply at the least cost of labour a foreign market at once ready and uncritical. Nevertheless the ancient skill of the greatest porcelain producers of the world,—those who taught all other nations,—still asserts itself, and examples were shown such as no makers of hard porcelain in Europe have yet equalled in their technical excellence as specimens of potting. The colours though as a rule wanting in the splendid qualities of the ancient Chinese work were occasionally very fine, especially some of the

Deterioration of modern art.

flowing or "splashed" tones. The stoneware on which these coloured glazes are used is sometimes of extremely hard, compact, and excellent quality. Stoneware.

Very interesting and instructive collections were shown of ancient pottery and porcelain, some specimens undoubtedly of early date, and among them pieces of great excellence and considerable value.

Character of European productions.

It is unnecessary in these preliminary observations to dwell here in any detail upon the character of the European productions, but one general remark may perhaps be worth making. Although there was on the whole, as must be admitted, a paucity of invention, either of new processes of manufacture or new applications of material, nevertheless some of the contributions served to illustrate what has often been observed of the almost inexhaustible fertility of the potter's art. The exigencies of some new process, the sudden development of some hitherto restricted trade, the mere shifting of the wind of fashion, all may be met and sometimes are so met by novel efforts on the part of the potter, and serve to prove that the most ancient art of the world has still many untried resources, and many fields still open to originality and enterprise. Of late days the wider spread of accurate investigation in geology and mineralogy has greatly aided the manufacture by the discovery of new veins of clays and of other minerals available for its processes. The careful analysis of many clays and other researches of experimental chemists, as well as the precise observations of scientific collectors, has also widened the field of labour.

Fertility of the potter's art.

Increased resources in modern times.

As examples of recent application of material or of decoration may be quoted the fine red and buff coloured ware exhibited from Copenhagen, vases, cups, &c., for the most part derived from graceful classical types, and frequently showing refinement and elegance of form and outline. The ornamental objects produced in clay obtained from Watcombe in Devonshire, statuettes, groups, vases, &c., of excellent and uniform tone of colour, were also examples of a manufacture of late origin, starting from the discovery of a peculiar and suitable clay.

Danish red and buff ware.

Watcombe Terra-cotta.

The large and important exhibitions of ornamental stone ware from Lambeth, and of painted faïence, prove how much may be done in a long known art by fresh energy working with knowledge and judgment. These wares will be fully noted hereafter. Their success has created several imitators in their own country, and given no small impetus to the production of this class of art-pottery. The best pieces derive their merit from the art bestowed on them, thus illustrating the possibility now as formerly of lifting a common, even rude material, to beauty and value, by securing the co-operation of competent artists. The money worth of mean materials thus dignified by art has appealed to not a few who may have been insensible to other considerations.

Lambeth ware.

It is satisfactory to see that the combination of ceramic products with more ordinary architectural materials is making way and receiving the attention which it deserves from architects and the decorators of the exterior and interior of buildings. In this direction the Exhibition contained much that was suggestive, not only in terra-cotta, and in wall and other tiles, but in stoneware for panels, bosses, attached columns, &c., also in materials for mosaic decoration either for external or internal use on the walls of buildings.

Modern application of pottery to architecture.

For many centuries the employment of pottery, more especially in the form of tiles, has been a chief resource in decoration among the masters of coloured surface ornament who enriched the mosques of Persia and other countries in the East. Their art, modified but still effective and splendid, reached Europe chiefly through Spain, and continues to linger in the traditions of that country; thus we find displayed in the Spanish collection a variety of mural and other tiles, many of which are capable of successful employment wherever sufficient taste or judgment in their use can be found or cultivated.

Following Eastern and Spanish precedents.

The use of terra-cotta in Europe for architectural purposes dates from an early period. In the first half of the 16th century it was already skilfully employed in England, and its great durability and capacity to resist the influences of an uncertain climate have been thoroughly proved. Tints can be also obtained in it which harmonize well with other architectural materials,

Employment in England early in 16th century.

so that it may become again, as it formerly was, a valuable aid in giving character and finish to otherwise homely structures. The exhibition of terra-cotta, although not as strong as might be desired, was, nevertheless, both suggestive and interesting.

Flooring and wall tiles.

The considerable and varied collections of tiles for flooring, wall, and other decorations were an interesting illustration of the revival and comparatively sudden development of an important industry. No great space of time has elapsed since the employment of ornamental tiles was a piece of antiquarian curiosity, and a wall decorated with them could only be discovered in some forgotten dairy or obscure passage where quaint Dutch or rude Lambeth plaques were still allowed to cling to the walls, or perhaps some space could be found where the now prized Liverpool tiles printed by Sadler and Green of a hundred years old were left *in situ*. At the present day, both in France, England, and elsewhere, almost every home where decoration has been attempted, has some portion of its interior walls bright with the gay colour and quaint with the clever subjects of modern mural tile-painting. This popular and pleasant art is fairly illustrated in the present Exhibition, and in the following report notices will be found of many specimens creditable both in design and skill of execution.

Their moderate use.

The encaustic and other flooring tiles included among them examples of thoroughly excellent work, which do infinite credit to the taste and judgment as well as the great practical knowledge and experience of their producers.

Progress in the United States and Canada.

The United States contributions of pottery will be found dwelt upon in some detail, as well on account of their importance as a manufacturing industry, as from the remarkable development to which they have recently attained. The porcelain exhibited is also specially noticed, illustrating as it does the first-rate character of the natural materials to be found in the country, and the laudable desire to utilise and to do justice to such material on the part of the manufacturers. It has, therefore, been thought well to preface the account of the American Exhibition with a statement in detail of the position of the industry, especially of its more important seat at Trenton, New Jersey, and to give statistics, as complete as could be obtained in the time, of the work being done by the energetic men who are gradually making their city of Trenton the Staffordshire of the United States.

Trenton, New Jersey.

In Canada the manufacture of the more finished descriptions of pottery is of very recent growth, but already shows signs of a skill and energy on the part of the manufacturers, which promises well for the future, and which could not fail to be regarded by Englishmen with special interest and satisfaction. Both "granite" and "C.C." or cream-coloured wares of good quality and workmanlike style were exhibited, as well as bricks of excellent manufacture, artificial stones, plumbago, crucibles, &c.

In conclusion, it is to be observed that besides the objects more especially dwelt upon in the foregoing observations, which from their nature are judged more or less from an æsthetic point of view, there were the varied and important collections of the products of the potter's art fitted for mechanical and scientific use. Respecting these the forms of the awards which it was thought right to bestow, carefully though briefly worded, constitute the best report; I allude now chiefly to the various fire-bricks, domestic, agricultural, and sanitary stonewares, chemical porcelains, &c. The importance of these to a great manufacturing country cannot be cverrated, and they were well, and, in some cases, very thoroughly represented in the Exhibition.

Sanitary and chemical ware.

Cements and raw materials.

There was also the class of cements and crude materials, besides the machinery for manufacturing them. Among the materials shown was an interesting series of china clays from Japan, of which specimens were carefully analysed by my skilful colleague, Professor Wurtz, of Hoboken. A brief abstract of the results of his exhaustive labour is given by his permission in the Appendix to this Report (page 69).

The range therefore of the group was, as has been already observed, very wide, and it is obvious that it would be impossible here to enter into detail respecting all the objects included in it.

I shall now proceed to notice the objects shown by each country that contributed to the Exhibition.

United States.

The United States exhibition of pottery was important from several points of view, not only from its extent, which was considerable; the evidence it afforded of the abundance of excellent natural material, and of great industrial skill in the use of such material; but also from the direct and formidable challenge it offered to similar wares of European and especially of British manufacture. State of the pottery manufacture in the United States.

The development of the industry has been wonderfully rapid, and even admitting to the fullest extent the advantage the founders have had from the employment of foremen and others trained in Europe, nevertheless the result attained reflects great credit on the energy, enterprise, and ability brought to bear on the manufacture. The self-reliance, which is so marked a characteristic of the American character, has strikingly come out in the progress of this industry; some have entered upon it without any previous knowledge or training, and yet by sheer perseverance, readiness of resource, and aptitude to learn have triumphed over their early difficulties and losses, and accomplished in but a short time what must be justly considered a remarkable success. Rapid development.

The chief seat of the manufacture is at Trenton, in New Jersey, the Staffordshire of the United States, but there is also an important factory at Greenpoint, New York, where porcelain as well as earthenware is made; and there are works in Philadelphia, Chicago, Ohio, and elsewhere. Seats of manufacture.

The following sketch of the rise and development of the manufacture may, it is hoped, be of interest, and the accompanying statistics will serve to show in some measure the present position and importance of the industry.

For the facts thus stated I am indebted to the laborious care and great courtesy of my friend General Hector Tyndale, one of the able colleagues with whom I had the pleasure and honour of being associated during my work at Philadelphia; the statements are taken almost verbatim from a paper he compiled for the report presented to the Commission, and of which he kindly furnished me with a transcript. I had also the opportunity of visiting Trenton, and being shown the important works there carried on by the energetic and enterprising proprietors of the various factories.

The principal productions are "granite" and "C.C." or cream-coloured wares; Parian is also produced, but not largely. The granite ware, resembling the stone china of English manufacture, is an earthenware of white body, fired at a high temperature and covered with a thin hard glaze. In the best specimens the body is extremely close, compact, and hard; the glaze thin, well incorporated, very hard, and not liable to craze. This ware is capable of bearing, without injury, sudden transitions of temperature, and in the hands of some of the manufacturers the preparation of the material and the turning out of the ware have been carried to great perfection. Wares produced.

The collection exhibited caused surprise from its extent and importance even to those acquainted with the immense advance made in the last ten years by the potters of the United States. The large space taken by the manufacturers in the Exhibition was fully and closely occupied by wares of excellent body and glaze, their own production, showing a great excellence of material and a high quality attained in what may be called almost a new body in pottery wares.

As regards the history of pottery in the United States, General Tyndale's interesting paper goes on to state that "coarse and bulky wares were manufactured in the country at an early period, probably reaching back to the middle of the last century. As far back as 1760–70 potteries of a better class were established, and gave such promise of success that Wedgwood, writing about that date, expressed his apprehensions as to the effect of them upon English "trade and prosperity." In 1769 porcelain works were begun in Southwark, Philadelphia, which existed for several years; but of these works unfortunately little is known. History of the art in the United States.

"During the war with Great Britain, 1812–1815, numerous potteries were established for making coarse domestic wares, even including some "C.C." or cream-coloured wares, which, after the conclusion of the war, were closed, as their productions neither in price nor quality bore any comparison with imported wares.

"From that time until about the year 1830 no effort was made to enlarge the number of potteries, other than those for making such kinds as could not be imported profitably, because of their cheapness and bulk. About the year named a porcelain manufactory was begun in Philadelphia in which was Porcelain in Philadelphia.

practicably shown the possibility of making in commercial quantities a hard porcelain of good and serviceable quality by using only the materials found abundantly in many parts of the United States. This serious attempt lasted for several years. The products were white and decorated table and tea services and ornamented pieces. These were sold at reasonable prices by an establishment in Philadelphia dealing mostly in them. The sales at one time reached to a considerable amount for the period. The body of this porcelain was sound, brilliant, and of great toughness, with a hard glaze. The decorations were not so successful owing to the want of proper artists, and, perhaps, to the lack of educated taste among the general buyers. These decorations were mostly in flowers and other similar subjects, somewnat stiffly painted in rather dull colours. This manufactory closed after a few years, leaving considerable loss to the enterprising and praiseworthy founders. Subsequently, and at intervals, other hard porcelain works were established on much smaller scales, generally for the production of door-plates, door-knobs, &c., and for cups and saucers, and other small pieces.

"These works generally met with indifferent commercial success, or with failure. At the present time, however, there are a few porcelain works firmly established and making these small pieces, together with very thick and heavy wares for the table use of restaurants, &c., with pecuniary success. From these it is hoped may arise large and valuable manufactures in which fine forms and decorations will be developed when art museums and art culture shall have been established at the centres of industry. During this period there also sprung up throughout the country many additional potteries making gray and yellow stone,—and "Rockingham" wares, &c., generally with success when properly conducted. As early as about 1850 many of these coarser potteries were successfully established at Trenton, N.J., and East Liverpool, Ohio, and elsewhere.

Various potteries established.

"At Trenton, about the year 1854, an effort was made to produce higher grades, at first by imitating to a certain extent the English "white granite" wares, of which very large quantities were and still are imported into the United States, they being entirely plain or undecorated. After some failures and much loss, and by persistent and praiseworthy efforts lasting through several years, this important manufacture was established about the year 1866, and was made a commercial success about the year 1870–73, and the resulting product is the present white granite "body" of the United States. Following this came other successful manufactories at Liverpool, Ohio, and at other places. It is to be regretted and condemned that in obedience to a supposed necessity the trade marks of well-known English houses were used, and in so far some of these laudable efforts and successes were stained with misrepresentation. At the present time, however, this bad and mean feature is nearly abolished, and the makers' names and addresses are used much to their honour and credit. The character of this now well-known ware is so nearly the same as produced by almost all the manufacturers, that a general statement of its qualities will pretty closely serve to describe the production of each pottery.

White granite ware.

Manufactories in United States, at Liverpool, Ohio, &c.

"Firstly, then, as to "body." It is very white, hard, and dense, being partly vitreous or vitrescent, and, for earthenware, having but little porosity and showing great plasticity; it may be rather too hard for the production upon it of the finest soft underglaze colours, particularly in printed patterns (which are now made in these wares mostly by printing *over* the glaze), though this will doubtless be amended if necessary.

"Body."

"From time to time, as may be required, many pieces of a moderately hard porcelain are baked in the same kilns and in the same firings with these wares, showing the high degree of heat attained in this manufacture.

"These wares more nearly resemble the hardest English white earthenware than any other "body," but are harder than those, although not so hard as the vitreous "ironstone china" made many years ago by Mason, and afterwards by Messrs. Morley & Co. and others, of Staffordshire, England. The entire freedom from spots of iron or other impurities is remarkable in this "white granite" body. The glazes are generally of good medium hardness, varying somewhat with the different makers; they are well incorporated with the body, and show but little tendency to "craze" (or crackle), and it is claimed by the American manufacturers that their glazes are more free from this defect than those of the wares of other countries. They are full and

Glazes.

transparent, with good capacity for receiving colours, quite equal to any observed, more particularly in the muffle hard fire colours, which in these glazes and upon this "body" come out very evenly and richly. It is perhaps to be regretted that a trade demand causes both body and glaze to be too much overcharged with blue, thereby injuring the colour of the wares and of the decorations placed upon them, and this, too, at an additional cost of manufacture. The forms of these wares are mostly made with a view to popular sale, being copied or adopted generally from the French and English. They are suitable for their purposes, and the ornamentation of handles and covers is fairly good. As a rule, rather more care might be taken with the fitting of covers. It is to be regretted that so large a proportion of this really excellent "body" and glaze should be devoted to the use of heavy, thick, and coarse cups and saucers, plates, dishes, and other pieces demanded by hotels and restaurants, and even by private families, throughout the United States. But several pieces of remarkable thinness and delicacy, made by Mr. Isaac Davies of Trenton, are shown, which evinced a high degree of plastic quality in the material the same as that used for the heavier pieces, and also show a very considerable skill in pottery. These last-named pieces are specially commendable as an advance in taste, and as a clear demonstration of the value of the "body."

Forms.

Mr. Isaac Davies, Trenton, N.J.

"The decorations as a rule are, as might have been expected in so young a manufacture deficient in originality, being copied mostly from the English or French. Generally they are suitable for their purposes, but are not of a high order, and often overdone; but there are some exceptions where good taste and judgment are shown. Some modelling done in Trenton is clean and careful, evincing considerable skill and knowledge. The prices of these wares, particularly of the large pieces, are low in relation to the cost of labour in the United States. The processes employed in this manufacture are of the most improved kinds, and the potteries, many of which were seen by the judges, are well arranged, very orderly, and highly commendable; all the materials used are found in the United States, and generally within a short distance of the several works throughout that country.

Character of the decorations.

Prices.

"There are now in the United States a large number of pottery works of all kinds, excluding terra-cotta and brick potteries, using a capital of about two millions sterling, employing about 12,000 to 15,000 persons, and giving an annual product of about 1,600,000*l.* to 2,000,000*l.* worth of goods. Of these the "white granite" and "C.C." wares have about 30 manufactories with about 110 kilns, having a capital of about 750,000*l.*, employing about 3,500 persons, paying about 250,000*l.* yearly wages, using from 50,000 to 75,000 tons of coal and about the same amount of other material annually, and producing about 600,000*l.* worth of wares per annum. The average prices of labour, &c. at these "white granite" potteries are:—

Present state of the manufacture.

Average rates of labour.

For common labour, per week - -	\$9 00
,, boys and girls ,, - -	\$3 00 and \$4 50
,, kiln work, per day - - -	\$2 25
,, pressers (journeymen), per day -	\$2 00 and \$3 00
,, jiggermen ,, ,, - -	\$2 50 and \$3 00

"The average price of used material is as follows*:—

Average price of material used.

	£ s.		£ s.
China clay, per ton - -	3 4	to	4 8
Ball clay - - - -	1 8	,,	1 12
Feldspar - - - -			3 12
Flints - - - - -	3 4	,,	3 8
Coal (anthracite) - - -	1 0	,,	1 2"

These statements, for which, as has been said, I am indebted to a colleague thoroughly informed respecting the pottery manufacture in his own country, justify what has been said respecting the rapid advance of the industry in the United States.

* These statistics were kindly furnished by Mr. Brewer, of Trenton, New Jersey.

Mexico and Peru.

Mexican pottery.

Passing from the United States, the other countries on the continent of America, with the exception of Canada, hereafter to be noticed, did not exhibit productions in pottery or porcelain of much importance.

Porcelain.

Mexico exhibited some few specimens of a porcelain remarkable for the extreme hardness of the body, rather coarse in texture, the fracture showing a vitreous fairly homogeneous paste so hard as to resemble the porcelain made at Plymouth and Bristol in England during a short period towards the end of the last century.

Decoration.

The coloured decoration in Chinese style showed some brilliant tones, but unequal in quality; the forms were unusual, and some good.

The attainment in the short period during which any attempt at making porcelain has been carried on in Mexico of this true porcelain body is worthy of note, and it would be interesting to see whether a commercial success in this direction can be realized.

Specimens of porcelain, decorated with subjects after Meissonnier and other French artists, were shown. There were a few examples of a ware nearly resembling Parian: also earthenware of red coarse body, inlaid with fragments of glazed pottery, and a red ware of better texture, glazed with a glittering black glaze very like that of the old Jackfield ware of the end of the last century, and also resembling some Portuguese wares. These have a native character in their design, and are the work of the present Indians of Mexico.

Terra-cotta and floor tiles.

There were also some specimens of terra-cotta painted in oil colours, with rude Mexican ornament; floor tiles of hard-brick clay, good body and sharply moulded, decorated in various colours of subdued tints.

Peruvian pottery.

Pottery from Peru was not represented otherwise than by a collection of the ancient ware, some of which probably dates from an early period. The forms, moreover, of the majority of the pieces were probably traditional, and belong in all likelihood to a remote antiquity. It is, however, unnecessary to do more than allude here to this collection, which was exhibited mainly for its historical and antiquarian interest.

Brazil—Argentine Republic.

Brazilian pottery. Description of exhibits.

From Brazil came red and yellow terra-cotta; some of fair quality. Vases with green and marbled glazes, hanging baskets of original design, open-work salt-glazed wares, and a black-bodied hardware; some specimens of "majolica," of red body, covered with a stanniferous glaze, and of good forms, were shown. Also tiles, but of rather soft body, decorated with transfer-printed designs.

This Exhibition was interesting as coming from a country seeking to develope and advance its resources, and it gives evidence of efforts which may lead to important success. It may be hoped, from the varied and valuable clays existing in Brazil, that pottery of a high class may hereafter be produced, and possibly works of a more distinctive character and style of decoration.

Argentine pottery.

From the Argentine Republic came a small collection of specimens of red and yellow terra-cotta roofing, flooring, and wall tiles, perforated bricks, and architectural pieces.

Canada.

Canadian pottery: granite and "C.C." wares.

Canada exhibited "granite" and "C.C." (cream-coloured) wares of good quality in compactness of body, glaze well incorporated, and fairly hard. The success attained is the more remarkable as the manufacture of these wares, so important for household use, has not been long established. Various glazed earthenwares were shown, stonewares, fire and other bricks. Chimney-pots and other specimens of terra-cotta were shown, but they were somewhat wanting in compactness and in cleanness of moulding.

Terra-cotta.

Stoneware.

Filters, jars, drain-pipes, &c. of stoneware were exhibited, and in these, as in terra-cotta, it is understood, a successful business is carried on. The manufacturers will no doubt examine with advantage the specimens of these goods, contributed by some exhibitors from Great Britain, where, especially in stoneware, the solidity of the body, its extreme hardness, the fineness of the glaze, and the accuracy of moulding leave little to be desired.

Nevertheless a great and most creditable advance has been made by the enterprising Canadian manufacturers, and that in a brief period.

Great Britain.

British pottery.

Leaving the continent of America for Europe, all the countries in which the manufacture of pottery or porcelain has reached importance were represented by their productions.

Position taken by Great Britain.

Great Britain was most prominent, and was entitled to the first rank among European exhibitors. Nevertheless it was to be regretted that some well-known firms had not responded to the requests made to them to contribute. All the more credit is therefore due to the energy and public spirit of those who, by their exertions, placed the manufactures of their country in a fitting position in this great competition, undeterred, moreover, by the obstacle of an almost prohibitive tariff checking the sale of imported goods, and thus diminishing the likelihood of any immediate return for their outlay.

Wide range of Ceramic wares exhibited.

The range of objects shown was of course wide. Porcelain of the finest texture at present manufactured down to cheap household goods; Parian and varieties of semi-porcelain; earthenware, glazed and unglazed; modern majolica and Palissy ware; stonewares of many different classes; terra-cotta, besides all the various descriptions of tiles, bricks, fireclay, terra-metallic goods, &c.

Lack of new varieties of production.

It was to be observed, however, that there were but few new varieties of production—a want of that activity of invention which stirred the energy of Wedgwood in the last century, and has left his name associated with more species of pottery than ever were produced, as far as is known, by any other manufacturer. The old paths on the present occasion were for the most part adhered to, and no doubt excellent work was shown, but it may be well to remind manufacturers that this is not enough; unless a higher order of intellectual activity is brought to bear on their art, unless the inventive faculty is stimulated, the pre-eminence they have attained will quickly be disputed, and ultimately lost. Again, art-knowledge of the best order that can be secured must be summoned to aid their work. Of course it is not in every generation that a Flaxman can be found, but the very ablest living artists must aid if pottery in Great Britain is to make a real advance, or even to maintain the position it now occupies among its foreign rivals. The highest triumphs in some former periods are as far above the productions of the present day as the Venus of Milo is above our modern sculpture; there is therefore no lack of standards of excellence sufficiently eminent in addition to that which every really capable man is certain to form in his own mind and strenuously labour to attain.

Necessity of art-knowledge.

Porcelain.

Of the porcelain exhibited much was to be commended for the quality of the body. This body, as generally produced in Britain, is, speaking without technicalities, a kind of compromise, adopted for practical reasons, between hard paste, such as Dresden, and soft, as old Sèvres. It has several advantages for manufacture, and especially for decoration over the former, while it is fitted for practical use, which was scarcely the case with the latter.

Body and glaze.

In the best specimens it is very compact, homogeneous, and translucent, not wholly vitrified, and the glaze is hard and brilliant.

Among the table, dessert, and tea services exhibited there were many altogether excellent in material and manufacture, in fact admirable specimens of pottery, and on some the colours were very fine, and the decoration deserved commendation.

The large collections of decorative objects included many specimens of considerable importance, not only as examples of skilful and complete workmanship, but also for artistic design and execution. And one notes with satisfaction that artists of undoubted ability are enlisted in the service of the principal manufactures, and the influence of their labours is very apparent. More has to be done, however, in this direction.

"Ivory" porcelain.

Among the materials of comparatively recent introduction which have been advanced to greater perfection is the "ivory" porcelain; a very elegant ware, having a soft rich effect of surface and agreeable tone of colour, due partly to a proportion of Parian body employed in its composition. Of this many

specimens were shown, some very delicately perforated, forming, as was the case with occasional specimens of old Chinese porcelain, an outer openwork case or covering to the enclosed cup, teapot, or other vessel. The skill with which this fragile casing is formed, attached, and fired speaks well for the dexterity of the artist-workmen employed.

Inlaid ware.

Clays of various colours are occasionally inlaid into this and other porcelain material, and produce a good decorative result. Such inlay work has been used by potters at various periods and in many countries, Oriental as well as European; but the most artistic and elaborate application of the process was to the ornament of the celebrated ware made at Oiron near Thouars (Deux Sèvres), in the 16th century, and commonly known as "Faïence of Henri II."

Painting in *grisaille*.

Specimens were shown of porcelain vases, cups, &c., painted in *grisaille*, in the style of the Limoges enamels on copper of the 16th century. Some of this painting was executed with much artistic knowledge and excellent skill, but notwithstanding these undoubted merits, the effect of the work is not wholly satisfactory; it too prominently brings before the mind the feeling that a method of decoration invented for one material to which it proved specially suitable has been reproduced upon another body wholly different, and for which it is less fitted.

Ornamental stoneware.

Excellence of material.

In ornamental stoneware the specimens exhibited from Great Britain easily distanced all European competition. The material is not surpassed for hardness and closeness of grain, and the glaze—salt glaze of the ordinary nature applied, however, with some distinctive peculiarities of manufacture—is well distributed and completely incorporated. In vases, ewers, drinking vessels, and various objects for table use the forms are often good, and the decoration appropriate; some recalling, as they are meant to do, the early Rhenish and Flemish *steingut*, but without the attempt at mere servile imitation which appears in examples of stoneware shown in the German section. The application of this glazed stoneware to architectural decoration is shown by specimens of plaques with bas-relief subjects, bosses, capitals of columns, &c.; combined with terra-cotta, its applicability to structures of considerable dimensions is illustrated. The ornamental use of this material is, in England, of comparatively recent date, and is mainly due to a higher degree of artistic skill than ordinary being brought to bear on their work by the principal manufacturers. A business of importance has in consequence been now established.

Application to architectural decoration.

Pulpit and other objects of Terra-cotta and Stoneware.

Among the great variety of objects exhibited—these specimens of English manufacture being among the most important and striking in the main building—were to be noted a pulpit of combined red terra-cotta and stoneware, remarkable for artistic design as well as quality of both the materials of which it was built up; a large wall fountain with well-conceived figure in relief; a font 3 ft. 3 ins. in diameter, with scriptural subjects in panels round the sides. Work so elaborately wrought out as these reliefs has scarcely been attempted in stoneware in England since the admirable and artistic productions of Dr. Dwight at Fulham in the end of the 17th century: a chimney-piece supported by side columns—the latter very successful. In the centre aisle of the main building was erected a circular temple 30 ft. high, formed of red terra-cotta and stoneware with flower vases round it. It gave striking evidence of the advance of the art of pottery in the combined materials of which we speak.

In the designing and carrying out of all these works, as well as in the smaller objects for table use or decoration, there is, as has been already observed, practical proof of the value or rather the necessity of artistic aid. The manufacture is excellent, the material well selected, well prepared, and well fired; but it might never have risen beyond a mug or a drain-pipe had not the skilful manufacturer been able to appreciate the worth of art, and to feel in what direction and to what degree these wares of humble and rude material were capable of being made decorative; and so his stoneware is seen mounted in silver, and does not misbecome its somewhat costly setting.

Methods of ornamentation.

It is needless here to do more than indicate the methods of ornamentation employed, as they are now widely known. While the ware is soft subjects are drawn on its surface with a style or pointed tool, and, when necessary, colour is added in the lines; surface modelling is also largely used. In other cases the decoration is given when the ware is hardened. The beading is mostly done by children, each pearl being placed separately. The salt glazing covers the whole surface with a very thin, hard, and equally distributed glaze, and by aid

of special methods of managing the furnaces during the process the colours applied to the wares are, when necessary, harmonised and blended together.

Sanitary and chemical ware.

The specimens of stoneware for drain and sewer pipes, traps, &c., and for chemical purposes, included some examples of work which reflected great credit on their manufacturers. A segment of sewer-pipe was shown 54 ins. in diameter, believed to be the largest ever made; it was in chambered sections, and was of admirable material and moulding, and altogether successfully potted. Also a stoneware jar for acid of the immense capacity of 620 gallons—a very remarkable example of skilled workmanship. Condensing worms of great dimensions and of very perfect construction were shown, and receivers glazed inside with acid-resisting glaze. A stoneware tap of 8 ins. diameter, a size not previously made, was also a specimen of first-rate potting and firing. Acid pumps in similar ware, provided with asbestos packing, were among the many examples of skilful and intelligent manufacture. A new joint for drain-pipes was to be noted, calculated to obviate the difficulty that arises when the bed of the pipes sinks, and the ordinary joint unsupported gives and becomes unsound; this is somewhat on the ball and socket principle.

Sanitary wares of excellent design and material formed an important part of the stoneware as well as of the earthenware exhibition; sink-traps of patent construction, ventilating and other perforated bricks, &c.—these of great solidity and true in form.

Terra-cotta.

Notwithstanding the merit of some of the specimens of terra-cotta, to which allusion has already been made, the general display of English terra-cotta was not such as might have been accomplished had some firms, devoted more exclusively to that manufacture, exerted themselves; the specimens already spoken of as combined with stoneware were nevertheless excellent in many respects. One example of the use of the material was sent which is quite unsurpassed for magnitude and importance. This was the colossal group representing "America," already alluded to, reproduced from one of the four corner groups of the Albert Memorial in Hyde Park; probably the largest work of this nature ever attempted in terra-cotta, and certainly carried out in a manner which showed great skill in overcoming formidable difficulties.

Colossal group, "America."

Suitability of Terra-cotta for architectural decoration.

The importance of terra-cotta for architectural purposes, especially in a climate such as ours, renders it in the highest degree desirable that manufacturers should turn their attention still more to its production; it is also to be hoped that their efforts to promote its use may not be hampered by combinations of workmen prejudiced against its introduction. As a material for the surface and decoration of buildings in cities where the impure atmosphere injuriously affects many kinds of stone terra-cotta is unequalled. It has already been successfully tried in London, and elsewhere in England, and has also begun to be employed in the United States: there is now being erected in Boston an important public building with decorations in terra-cotta; the latter material being, however, supplied from England.

Superiority of English Terra-cotta.

In this country its introduction is at first encountered by apathy, by dislike of apparent novelty, by difficulties created by combinations of workmen; these obstacles do not arise in America, and it is therefore more essential that the existing superiority of the material as produced in England should be fully maintained if English firms are to continue to supply their terra-cotta to American architects. At present this superiority is marked; terra-cotta was shown from many countries including France, Germany, Spain, Italy, Portugal, Sweden, and Denmark, but from none of these did there come any equal in quality to that manufactured in England. The use of terra-cotta though sometimes imagined to be a novelty is not so in England; on the contrary, as has already been stated, the evidence of long experience can be quoted to prove its peculiar fitness for employment in the climate of Great Britain. Specimens dating from the reign of Henry VIII. have been till recently, and some are, *in situ* at the present time; these and others up to the date of the last century examined by the writer have been found in perfect preservation. The terra-cotta is red, and resembles not a little the closer kinds of Roman brick.

Its suitability to the climate of England.

Floor and wall tiles.

Floor and wall tiles and others for various decorative purposes were shown by many exhibitors and in great variety, this branch of industrial pottery, as has been observed in the introductory remarks, having developed during the

last few years to great importance. Of the floor-tiles the body of the best was very compact, hard, and uniform; nevertheless a still more resisting material is needed, no ornamental paving-tiles yet produced having been found able to bear the foot traffic in some of our public buildings.

Greater durability needed.

The want of equality in the wearing of the tiles is a present defect. In red tiles inlaid with a green diaper, the red gives way under the constant tread, leaving the green portions prominent. Again, in the buff and red, the former sometimes disappears under wear which the red bears fairly, and so with other tints.

Good designs of tiles.

The designs of many of the tiles exhibited, both painted and encaustic, were satisfactory in composition and colour, not confined to suggestions however excellent derived from mediæval or cinque-cent work, but endeavouring to take a wider range over the field of art.

"Terro-metallic" tiles.

"Blue brick" paving-tiles.

Broseley and Stourbridge bricks.

Tiles of fire-brick body, "terro-metallic," for pavement of stables, gateways, and other places of heavy traffic were shown, extremely dense, hard, and tenacious. The "blue brick" paving-tiles of similar character were also to be commended for solidity and resisting power. Quoin-pieces, and others for string-courses and various architectural requirements, were well and cleanly moulded and of the greatest density; perforated tiles for malting-houses extremely well made were also exhibited. Altogether the Broseley and Stourbridge bricks, paving squares, tiles, clinkers, &c., were of a quality which fully justified their reputation. Hearth-places of fire-clay were shown adapted for burning wood where fire-dogs instead of grates are used.

France.

French pottery and porcelain exhibit not fairly representative.

The exhibition from France was of considerable extent and variety; nevertheless it did not justly represent what France is at the present time capable of doing. When some delicate kinds of porcelain had been examined, and the large but not satisfactory collections of decorative faïence, the reproductions of Palissy and majolica wares, together with some earthenware for household use, the visitor's work was almost done. A few special pieces and processes will be presently brought under notice. The great reputation which France deservedly enjoys for excellence in ceramic manufactures might be said to be sustained but not advanced; her position relatively to some other countries, especially Great Britain, is wholly altered from what it was some 25 years ago; this is owing not to deterioration on her side, but mainly to the strenuous efforts which have been made by her competitors, who have, nevertheless, much still to do. The strength of French decorative work lies in the knowledge of the figure which her artists have been trained to acquire and use, and in which the best of them have gained a considerable mastery. Those who seek to rival them in their own or similar fields must acquire that chief and primary knowledge, and must have what at present scarcely exists in England, encouragement and scope for its use. The only great English designer and decorator of pottery, Flaxman, was also our greatest master of the figure.

Orientals superior to European in surface decoration.

Nevertheless it is not to be forgotten that outside this field of art there lies another,—that which we recognise as "oriental," and that they who labour in that field still employing motives sanctioned by immemorial tradition surpass in surface decoration so immeasurably their European rivals that the latter toil after them in vain with feeble and almost ludicrous attempts at imitation of their gorgeous results. The Japanese exhibition was, as will presently be shown, ample proof of this superiority.

Hard porcelain.

Among the specimens of hard porcelain of French manufacture were some cups of extreme delicacy of texture, potted with skill and fired with entire success; the colours, limited, of course, by the conditions of the firing of hard porcelain, were well harmonized. For these specimens an award was recommended; the reticulated and striated surfaces of these very thin cups, just sufficiently indicated by the varying tone of the colour caused by the filling in of the glaze, had a pleasing effect.

It was to be noted that one at least of the French exhibitors showed the application of a considerable variety of colours to hard porcelain, and in tints rivalling those of *pâte tendre*. The results of a special process were also shown, in which, without indicating details which the manufacturer was unwilling to publish, it may be stated a successful effect in decoration was obtained by means of chromo-lithography.

Soft or medium paste also was exhibited of fair texture, white and well glazed.

A special method of decoration of hard porcelain of recent introduction was illustrated by several specimens. A platina ground is prepared, on which colours are painted, giving them a peculiar and pleasing effect of soft tone; the platina is in appearance intermediate between bright and dead or oxydised silver, and gilding applied to it tells very advantageously. Many firings are required, and the heat necessary is very great. Only hard porcelain is therefore capable of bearing the requisite degree of temperature and of being so decorated. Special method of decoration.

Artists of reputation, whose designs are highly paid for, are employed by the chief French houses.

The collection of decorative faïence, a traditional specialty of France, was, as might be expected, large and various. Suggestions are freely borrowed from the old styles, but a tendency to mere reproduction is too obvious. Palissy ware is skilfully imitated, as are the old works of Nevers, Rouen, Strasbourg, Moustiers, &c., and just in proportion as the enthusiasm of collectors and antiquaries increases and consequently exaggerates the importance of what has merely the interest of age, so the manufacturers vie in mimicking the works of byegone times, and succeed very completely in reproducing all the defects of their models. Decorative faïence. Reproductions of old styles.

The modern error most frequent in England of over-glazing, which the old workmen shunned, is not altogether escaped in France; nevertheless good work was shown. Great efforts are being made to reach excellence in colours, and this is mainly due to the appreciation felt by the French generally for fine oriental porcelain; the desire to compete with its splendid colours has stirred the ambition of manufacturers. A good turquoise, and a very fine bleu du roi, the gorgeous tint first suggested by old oriental china, has been produced, also some flowing or splashed tones of rich quality. Over-glazing.

Nacreous or pearl porcelain was exhibited, but in this, as in the somewhat similar Belleek manufacture, specimens of which were shown by English exhibitors, the glaze is wholly overdone. When very sparingly used it can be made effective and even artistic, but the lavish employment of this intensely glittering vehicle on exterior surfaces moulded or modelled in relief is altogether a mistake. Pearl porcelain.

A considerable collection of majolica was shown, for the most part in the style of the early Urbino and Faenza ware, and of the later Abruzzi work, but no striking success is attained in this direction; it serves to illustrate, as so much else in modern pottery does, the homely saying that those who follow must be behind. Where, however, a new path is struck out the results are occasionally deserving of notice; this is the case as regards some of the statuettes in glazed and coloured faïence. A pair of Maccaroni figures in full costume are quaint and extremely clever. Majolica.

No figures, however, shown by France, or any exhibited by other countries, surpassed in quaint excellence the series of small red terra-cotta groups and statuettes modelled and produced by M. Eugene Blot and his son. These little works illustrate fishing life at Boulogne, and are quite admirable, full of artistic expression, handled with force and freedom, the groups well conceived and ingeniously carried out. They have the dexterous cleverness that was conspicuous in the Italian Pinelli's work in the early part of the present century, but with more variety and minuteness of observation. A group of nine figures, entitled "Les Pecheurs sur le Port," with fish of various species, nets piled up, baskets, &c., was specially remarkable. Terra-cotta statuettes.

In addition to the collections in the Main Building certain specimens of French porcelain were shown in the Fine Arts Department in the Memorial Hall. These were chiefly vases of large size and elaborate decoration, coming from the National Manufactory at Sèvres. Among them were a few elegant in outline and fairly successful in combination of colour, the individual colours being almost invariably excellent. All of them were fine examples of successful potting and glazing; the bleu du roi on one piece was splendid. Sèvres vases.

Porcelain flowers are produced in France with singular skill and sold at a very cheap rate. Those exhibited included some pretty pieces most ingeniously imitated from nature, dexterously modelled, well fired and coloured; Porcelain flowers.

except some specimens sent by a maker in Prague, no others competed with the French examples.

Germany.

German pottery and porcelain.

The German collections of porcelain and pottery presented no features needing to be dwelt upon.

Technical and artistic shortcomings.

The body of the best porcelain shown was hard, even, heavy, fairly compact, and the glaze was hard and glittering; the gilding not generally of high quality; the potting, as regards fitting of lids, &c., was but moderate; the decoration for the most part was drawn with precision, but was hard and unpleasant in effect. Massed together the porcelain is cold in tone, inharmonious in colour, and wholly wanting, on the one hand, in the refinement which gave a charm to the *pâte tendre* of Sèvres, and in the depth, richness, and harmony of colour which places oriental china first for decorative purposes among ceramic productions.

Some exact reproductions, as regards form of old Dresden designs, were shown, and others of old Berlin vases, &c.; on these latter the flower painting was very good.

Inferiority of "biscuit."

The biscuit porcelain exhibited was for the most part somewhat bluish in tone and hard in surface; its tendency in shrinking is to become sharp at the edges. The tendency of Parian is the reverse, and thus the biscuit is wanting in the soft fleshy character of the latter material. A wine-cooler exhibited may be considered a *tour de force* in this material from its unusual size, about 3 ft. by 2 ft. 9 ins.; the original example produced was shown in London in 1871, and was wisely left white; the present specimen was coloured, and coloured in extremely bad taste.

Bad taste in decoration.

Superiority of chemical ware over that of other countries.

In one ceramic material the German product was the best shown—in chemical ware, that from Berlin being superior for all practical purposes to any other in the Exhibition.

Stoneware.

Stoneware vessels, jugs, tankards, &c., somewhat in the style of the old Nieuwied ware, were exhibited, hard and fairly solid in material, and produced at a very cheap rate, but crude and unpleasant in colour; in this last respect quite unlike the old ware they sought to imitate.

Fittings for furniture, door handles, &c., and apothecaries ware were shown of hard compact body and good glaze—also well potted and fitted.

Wall and floor tiles.

Encaustic wall and floor tiles of good quality in material were exhibited; also others of white body, plain and glazed. Some were coloured to imitate porphyry and various marbles, others had designs of character suited to their object, and in unobtrusive tones of colour; they are well fitted for mural and other architectural decoration. The factory is stated to produce at present 130,000 square metres annually.

Austria.

Austrian porcelain, pottery, &c.

From Austria came considerable collections of porcelain, also examples of stoneware, faïence, and other earthenwares.

Porcelain.

Porcelain was shown of fine hard body, well manufactured, chiefly remarkable for the careful imitations of the works of various ancient and other fabrics. The reproductions of the old Meissen services were very skilful, more especially in form; the coloured decoration was not equally successful, and so with the oriental porcelain, where, as might be expected, the harmony of tints had somewhat baffled the European painter; this was especially to be noted in the case of a large vase 4 ft. 6 ins. high, remarkable otherwise as a specimen of potting, but intended to represent Japanese decoration, which it succeeded in caricaturing. The rococco styles of the last century were imitated with success.

Perforated porcelain.

Perforated porcelain is made very skilfully, and specimens in the old Chinese style of this special manufacture were in respect of their form and the completeness of the perforated work quite successful.

Bohemian porcelain.

From Bohemia came some excellent hard porcelain, of compact, vitreous body and good glaze; the designs for dinner, dessert, and tea services were commendable. Some of the latter more especially were very neat and suitable. A biscuit porcelain ewer, 33 inches high, was decorated round the drum with

scenes in high relief from the lives of various German landsknechts—an elaborate composition.

A collection of porcelain flowers, wreaths, and other ornaments was shown; some of the blossoms were very successfully imitated. Porcelain flowers.

Stoneware in the style of the old Rhenish *steingut* was of compact hard body and fairly modelled. Some pieces were decorated with printed designs, others hand-painted. Stoneware.

ITALY.

The collections exhibited from Italy consisted of majolica, terra-cotta, Della Robbia ware, and a few minor objects. The general impression of the Exhibition was that the potters and artists are too well content to rest upon the reproduction of the thoughts of more artistic days, and though possessing much cleverness, and a certain manipulative skill, they are wanting in originality, and in that well-considered knowledge of the potter's art which leads on to invention. Italian pottery works destitute of originality and invention.

Much majolica was shown in the styles of the 16th, 17th, and 18th centuries, the decorations often not ungracefully imagined and boldly drawn. The old work from Urbino, Caffaggialo, Pesaro, Faenza, &c., had served as models for much that was exhibited, and the lustres employed by Maestro Giorgio at Gubbio were sought to be reproduced, and some, even the famous ruby lustre, with considerable success. This most brilliant means of enhancing the decorative effect of pottery was used in some examples with judgment and skill. Majolica.

As clever reproductions of a past style, some large majolica plates were remarkable; these are stated to be painted with the colours traditionally known to have been employed by the early artist-potters; their close adherence to the character and effect of ancient work not of a high order was their most noticeable quality.

A few statuettes covered with a thick stanniferous glaze in the manner of the early Della Robbia ware had merit, and one standing figure, about 2 ft. 6 ins. high, was a very excellent work, dignified in pose, expressive, and well draped. Other terra-cotta statuettes in the style of Clodion were shown, and a rather pretentious fountain group in the same material. Among the clever reproductions of old methods of decoration should be noted specimens of *sgraffito* ware excellently imitating the early work: this, however, is to be commended, as it may easily advance beyond mere reproduction. Imitations of Della Robbia ware. *Sgraffito* ware.

Signor A. Castellani exhibited in the fine arts galleries (not for competition) a valuable, interesting, and instructive collection of early lustred pottery and Italian majolica systematically arranged, commencing with wares of the Sicilian-Arab period and continuing until the time of the Abruzzi painted wares. Signor Castellani's collection of early pottery and majolica.

Among the early specimens were some of oriental type, rich in colour and lustre, forming links between the Arab and the Spanish-Moresque art; these, notwithstanding occasional rudeness in execution, were good in design and most effective in colour. A small vase of splendid purple glaze, lustred, was shown among this class, apparently of Persian origin. Arab and Spanish-Moresque.

Next in order were the large dishes or plateaux of Spanish-Moresque manufacture, brilliant with red and golden lustres, most effectively employed, and giving examples of a decoration bold and rude in execution, but gorgeous in result. This forms a most suggestive style of ornament, which has been imitated by modern makers with considerable success.

These wares having been early carried to Italy suggested or stimulated the manufacture of similar earthenware in the northern cities. In the early part of the 16th century there arose at Gubbio the manufacture in which Maestro Giorgio Andreoli seems to have invented the splendid ruby lustre with which his name was associated until his secret was lost and the art died out. Some valuable specimens of his work were shown, one dated 1525: such pieces as these are suggestive examples of the use of rich colours in the decoration of pottery, and are now generally recognised as deserving the careful study of artist-potters. Gubbio ware.

The manufactures of Caffaggiolo, Urbino, Faenza, and of Venice were also illustrated by examples, many of which were characteristic and some important. Among these were included plates decorated by known artists. About the year 1600 these "subject" pieces began to lose something of their fine Caffaggiolo, Urbino, Faenza, Venice, &c.

qualities of colour and execution, and soon after a decadence can be traced which was not checked by the Abruzzi and Neapolitan schools of majolica painting. In these latter a lavish profusion of subject prevails; the figures are freely drawn but feebly coloured, relieved often with gilding; in many examples landscapes treated with picturesque effect, but generally pale in tone, form the chief part of the decoration. This style lasted to the end of the 18th century. It was sufficiently represented in this well-selected and judiciously exhibited collection.

Spain.

Spanish pottery.

Spain contributed collections of various glazed and unglazed potteries, porous ware, lustred and other tiles, artificial stone, terra-cotta, &c.

Elegance of shape in vessels of domestic use.

Among the vessels for ordinary every day use were many of antique forms, often elegant, which have no doubt been traditional in the country since classical times; others of oriental character derived from the Moorish period: these for the most part are rudely and unskilfully manufactured, but are sold at prices which on first inquiry seemed impossibly low; their cheapness was explained by the slight value of labour in the districts where they are produced. The grace of outline of many of these vessels of commonest use render them valuable as models to potters of the present day who would otherwise despise their obvious imperfection. The greater part of the collection was bought for museums in the United States. Some large dishes of a coarse majolica were decorated with colour in a fashion almost grotesque in its rudeness, but nevertheless effective.

Majorca ware.

The vessels of porous cream-coloured ware, chiefly from the island of Majorca, are curious examples of ingenuity in manipulating clay, covered as they are with quaint devices of ornament in relief.

Tiles for wall decoration.

Spain has long been notable for coloured and lustred tiles for wall decoration. A large collection from many exhibitors was shown, and among them some of rich and vigorously-designed patterns; the colours, though apt to become gaudy, are at times not only forcible and effective but harmonized with something of Eastern skill.

Roofing tiles

Roofing tiles were shown, of coarse make but glazed with deep and rich tints such as must produce a fine architectural effect under a southern sun.

Portugal.

Portuguese pottery.

Portugal showed in a well planned and arranged collection some remarkable glazed faïence, rich in the colours of its bright and lustrous—sometimes too lustrous—glaze; fine greens, browns, and a good umber yellow were exhibited, figures and animal forms being notable in the collection.

Some of the mottled glazes recall the work of Whieldon in Staffordshire, in the middle of the last century, and as there was intercourse of trade between Portugal and our potteries, and one of the old English marks was adopted in that country, it is not improbable that the glazes still used are the tradition of what was then learnt. Some of our own potters are returning to them, and endeavouring to bring back the fine tortoise-shell and mottled brown tints employed by Whieldon and Wedgwood.

Terra-cotta.

A few statuettes were exhibited modelled in terra-cotta, and coated, as in Della Robbia ware, with a stanniferous glaze. Of these, one was admirable in design.

The terra-cotta and architectural pottery exhibited was not of first-rate character.

On the whole, the merit of the pottery consisted in occasional elegance of form and frequent richness and depth of colour in the glaze.

Belgium.

Belgium pottery.

Belgium exhibited pipes of red and black stained ware of cheap manufacture, in which a very large trade is carried on; also pipes and cigar-holders of various colours, some cleverly modelled into grotesque heads, and with brilliant glazes.

Holland.

Holland scarcely vindicated her ancient reputation as a manufacturer of pottery, her exhibition being but meagre and not doing full justice to her skill. Nevertheless in one production the Dutch exhibitor was easily first, in the specimens of the long white clay pipes from Gouda, so long a speciality of the country. Some of these showed skill in manufacture apparently not equalled elsewhere. The favourite *tour de force* in pipe making was of course to be seen, pipes with the very long tube tied into an elaborate knot, and yet fairly retaining its roundness. Dutch pottery. Tobacco pipes.

Wall-tiles, for which Holland has long been celebrated, were shown, but not in much variety. The old Dutch designs were reproduced on some; others were printed and marbled, the quality of body fair, and the glaze good. Roofing-tiles, drain-pipes, and fire-bricks were exhibited, and especially the small hard paving-bricks more extensively used in Holland than in any other country; of these, many varieties were shown, all good, and some of excellent quality. Wall tiles. Roofing-tiles and paving-bricks.

Denmark.

Biscuit porcelain, statuettes, and plaques of excellent manufacture were shown. These are produced in very large quantities in Copenhagen, and have since their first exhibition in London been exported largely and sold at low prices. The collection was not sufficient to do justice to the manufactory which produces a great variety of statuettes, bas-reliefs, &c. The designs are for the most part after Thorwaldsen and other artists of the classical school. Danish pottery.

The biscuit is very hard, clean in moulding, of good surface, and generally of fair colour. It is wanting in the soft appearance of the old Sèvres biscuit, and in the beautiful surface and mellow tone of colour seen in the old Derby.

By far the most successful collection exhibited from Denmark was a good and well selected series of small vases, tazze, cups, &c., in fine terra-cotta, of the types with which, since our International Exhibition of 1862, we have become very familiar in London. These are carefully designed for the most part from classical models, are delicately modelled, and most skilfully potted in a very fine clay, becoming pale red or buff in firing. The excellence of texture attained in the preparation of the material and completeness of the work are most commendable, and the decoration is generally well adapted to the antique character of the forms selected. The subjects are from Thorwaldsen's works, and are for the most part well drawn, though wanting, as must be expected, in that indescribable grace and ease which in Greek work resulted from the artist creating as he drew. The figures are in black, occasionally touched with dark red; some specimens are ornamented, on the black ground, with wreaths of flowers, fruits, &c. in oil colours. Terra-cotta vases, &c.

Russia.

Among other ceramic productions Russia contributed two groups in terra-cotta that claimed notice for effective design—a boy holding a monkey and a boy and girl with a bird. These were of yellow terra-cotta, rather soft in quality; they were the original models by the artist. Also an interesting series of specimens in similar material, decorated with strong and vivid colouring in a characteristic and altogether national style; the motives of the ornament, which are in fact traditional, are taken from works dating between the 11th and 16th centuries. There came from Moscow, from the Art and Industrial School, a similar class of work; there efforts are being made to foster and direct the native styles of ornament, not to supersede them. This effort may suggest to us how best to deal with art-schools in India, whose influence otherwise may prove disastrous to the ancient traditional art of surface decoration, in which the natives are certainly better fitted to teach us than we them. Russian pottery. Ornamentation.

A small collection of porcelain plates, cups, and saucers represented, but not sufficiently, the productions of a large and important factory at St. Petersburgh. The designs of the decorations had some originality of character, and were rich in effect. St. Petersburgh Factory.

Sweden.

Swedish pottery.—Sweden exhibited porcelain, Parian, biscuit, glazed pottery of various descriptions, stoneware, terra-cotta, and fire-brick moulded in various forms.

General excellence of works exhibited.

In each of these classes of manufacture specimens were shown that deserved commendation. Notably a marbled ware, and a "majolica," as it is not very correctly named, which was pleasing in tone of colour, fairly moulded, and well glazed. Some very large pieces of decorative earthenware were exhibited, especially a chimney-piece, a fire-stove, good in colour and general effect, and two very large candelabra.

Stoneware.

The salt glazed stoneware was of serviceable character and quality, well moulded, and showing in cheap objects of ordinary daily use an introduction of ornament which evidenced taste as well as skill on the part of the workman. This was the more observable as unfortunately in most stoneware of this character any appearance of ornament seems to be shunned as though it were "unpractical," and thus in our own country at least the poorer classes continue to be surrounded by hideous pottery in the production of which science indeed has been consulted, for as an industrial product it is successful, but art has been wholly ignored. It might be well for the producers of such wares to observe—what is a matter of fact—that a pretty object sells best;—to this argument they would be accessible.

Terra-cotta.

The terra-cotta was of fair quality. A dark grey variety for architectural purposes was shown, having much the appearance of Italian *pietra dura;* this was successfully moulded and fired, as was proved by a specimen column the drums of which fitted with sufficient accuracy. Its effect in building would be too sombre.

Sanitary ware.

The fire-bricks, cheek-pieces for grates, &c., were of sound quality, and altogether well manufactured. There were also drain and sewer pipes of stoneware of very fair quality.

The whole exhibition evidenced directing energy, enterprise, and skill, and sufficiently proved the independence of Sweden in the production of the class of products here alluded to. One factory produces to the extent of about 80,000*l.* sterling annually.

Rörstrand Company's system of marking date of manufacture.

The Rörstrand Company mark on important pieces the date of manufacture; a desirable practice which might be copied with advantage by English houses, especially those who inherit well-known names, and whose wares are sometimes purchased by dishonest dealers to be sold as "old" specimens.

Turkey.

Turkish pottery.

Turkey exhibited collections of small objects—cups and saucers, bowls and covers, pipes, &c.,—in earthenware. Some of these were of dark body, stained black on the surface, and ornamented with designs in silver or white metal inlaid in low relief. The designs had considerable elegance. Others were of a red terra-cotta body, also stained black on the surface, and having incised patterns of characteristic designs, good in style and decoration, the ornament being well harmonized with the forms.

Some red ware was shown with the surface polished on the wheel and enriched with gilding, the composition and character being similar to the Siout ware from Egypt, the decoration skilful and effective. Specimens of yellow earthenware for domestic use, mostly green glazed, were exhibited, among which were pieces which, although somewhat rude in material and manufacture, had the merit of good and even artistic forms.

Japan.

Japanese pottery and porcelain.

Importance of collections shown.

Passing to oriental nations the exhibition of porcelain and pottery from Japan surpassed in importance all other collections of similar nature brought to Philadelphia, not only from the extent of the collection, but from its varied character, its general high standard of excellence, and the unrivalled importance of individual specimens.

Number of factories.

The number of factories at work in the country is great. About 35 localities or districts are named, in each of which many potteries are established. Some of these are considerable centres of manufacture where for upwards of 300 years the potter's art has been carried on; and around several of these centres are grouped villages or hamlets producing wares having distinct characteristics.

The total number therefore of distinct species, so to speak, of pottery and porcelain is very great, and indicates a remarkable activity of invention, and a widely diffused knowledge and skill in manufacture; still more remarkable to Western notions is the diffusion and abundance of art-power, the result it may be of the training and experience of uncounted generations now become almost an instinct. Variety of wares.

Conspicuous among the porcelain-producing localities Arita in the province of Hizen; perhaps the most important seat of the manufacture in Japan, and in this part of the country remain the descendants of the Corean potters brought over in the 16th century. Round it are grouped many factories producing various descriptions of stoneware, faïence, and porcelain, which are gradually beginning to be known and discriminated by European collectors. Of these kilns in the province of Hizen those at Karatzu are the most ancient, and in this neighbourhood coal mines exist. Near Nagasaki also, from which Arita is distant some 50 miles, are now at work factories making very large quantities of ware; some pieces conspicuous for their great dimensions and skilful potting came from this locality. Centres of manufacture. Arita. Karatzu. Nagasaki.

At Arita a company has recently been established who exhibited largely at Philadelphia, and who seem to be prosecuting the manufacture with singular energy and considerable success.

Sedo, about six miles from Nagoya, in the province of Owari, is also a very ancient seat of the art, dating back at least to the early part of the 13th century; at that date a Japanese potter went to China, and on his return, having seen the Chinese potteries, settled at Sedo. Clay of suitable quality was early discovered there, and now many other localities in the province possess factories. Porcelain is produced decorated in blue, and also grounded with the fine red colour obtained from oxide of iron and enriched with gold, but not commonly so delicate in quality as that from Kiyoto. Sedo.

From the province of Kaga comes the Kaga or Kutani ware, taking its name from Kutani-mura, a mountainous district, where the clay used in its manufacture is found. The factories are in the village of Yamashiro, at some distance from the quarries; the nature of the ground in the immediate neighbourhood of the latter and the inclemency of the winter season preventing the establishment of works within easy reach of the supply of material. Of the porcelain made the most notable is very fine egg-shell of extreme delicacy ornamented in red, and sometimes much decorated with gilding. Kaga or Kutani ware.

In districts of the government of Kiyoto families of Coreans continue the art which they have practised there for many generations. From Awata, in Kiyoto, comes a fine description of earthenware, called by the name of its place of manufacture, resembling Satsuma, but paler in colour. Porcelain is also made there. The so-called "Raku" ware, a species of earthenware—the word means "enjoyment"—came from the old capital of Kiyoto, where a Corean introduced it in the 16th century, the clay of which it was originally made being found at Shiraka. "Raku" ware of many varieties is now produced in various localities. In and about Kiyoto are more than a dozen factories making a considerable variety of wares, and from this district comes the "Eraku" ware, so named after a potter of Kiyoto who first made it; it is a gorgeous decorative porcelain with red ground covered with ornaments in gold, generally mythological subjects. Awata ware. "Raku" ware. "Eraku" ware.

Awaji ware comes from an island of that name, and is made in the village of Iganomura. The best specimens are of a delicate yellow tint, the glaze showing a minute reticulation of fine cracks, the decoration executed in colours more or less transparent. Awaji ware.

The well-known Satsuma ware is, as at present produced, a creamy white hard earthenware with a fine glaze, composed of feldspathic materials and lixiviated wood-ash, always minutely crackled; the decoration in enamel colours often of great brilliancy. It is chiefly produced in factories near Kagoshima, in the province of Satsuma, and there about 1,500 potters are employed; but successful imitations of this ware, a great favourite in Japan, are made in some other districts, notably at Ota, in the neighbourhood of Yokohama, and lately at Yeddo. Satsuma ware.

The original Satsuma ware was introduced from Corea in the latter half of the 16th century. It was then a stoneware, and at the same period a white ware resembling Corean porcelain was also manufactured. About the end of the Introduced from Corea.

16th century the present style of Satsuma ware was commenced also by the Corean potters who had been brought over by a Prince of Satsuma after a successful invasion of Corea. The ancient ware is very delicate, elaborate, and fanciful in its coloured decorations, and is much prized. Recently, however, it has been imitated with such skill, and the appearance of age given so craftily to modern pieces, that even a practised eye may be deceived by their appearance. Two large vases shown at Philadelphia were thus made professedly in imitation of ancient work, and they were triumphs of skilful reproduction, the "patina," so to speak, of time being given to their surface, and the effects of use and wear closely imitated.

"Banko" ware.

The "Banko" ware is so called from the name of a potter who introduced it about 1680, and it was made in Kinume-mura, in the province of Tokio, and is now produced in the province of Ise. It is a very remarkable kind of hand-made pottery, and will be further noticed hereafter.

"Sometsuki."

From the province of Mino came large quantities of "sometsuki," that is, painting in blue on white porcelain, with oxide of cobalt under the glaze; the native ore is used for ordinary purposes, but the finest blue is only obtained by the use of materials imported from China, and thus alone can the exquisite quality of the ancient Chinese blue and white of the 16th century be approached, though not equalled.

Tokio is a considerable manufacturing district, and here also, as at Yeddo, much decoration of ware produced elsewhere is done. From Tokio came, among other specimens, very remarkable examples of cloisonné enamel on porcelain; not only cups and small objects, but large vases, jars, &c.; others were shown from Nagoya in the province of Owari.

Excellence of Japanese exhibit.

The general effect of the Japanese exhibition was very striking; its remarkable extent and variety, the splendour of colour, the great size of many of the pieces which for works in porcelain might be without exaggeration called colossal; the range of periods apparently represented, not only by the exhibition of a series of rare and curious specimens of early date, but also by the reproduction on a large scale of the styles of ancient wares in works imitating them with extraordinary and deceptive precision; all these considerations rendered the collection most deservedly interesting and attractive.

Blue and white porcelain.

The specimens of blue and white porcelain—that is, chiefly of "sometsuki" or painting on white ground with cobalt under glaze—constituted in themselves an important exhibition, those especially from the province of Owari. The great size of some of the slabs of porcelain, the table-top already alluded to, of 6 feet in diameter, being here shown, as well as of the vases, one upwards of 6 feet high, the perfection of their manufacture, and the splendid skill of their decoration, all gave evidence of the position to which the art of porcelain making has attained among this enterprising people. Large flower vases, 3 feet in diameter, and nearly the same in height, decorated with flowers in white, in low relief upon a deep blue ground, were admirable specimens of successful potting. Another piece that naturally attracted much notice was in form of a large drum, supported on a stand, and surmounted by a figure of a cock, all in porcelain—this is emblematical of a period of peace and contentment: the drum called "Tai-ko," which was anciently set up so that aggrieved persons might by striking it appeal to justice, is here seen to remain untouched, and to become the undisturbed perch of a fowl.

Some of the plaques of porcelain painted in blue, made for the purpose of enriching carved and otherwise decorative furniture, were excellent and effective in design.

Among the specimens from Arita, in the province of Hizen, were the great flower vases mentioned in the early part of this report, splendid specimens of art-work; besides these were large circular dishes of porcelain, some nearly 4 feet in diameter, admirable as examples of potting, and altogether magnificent as pieces of decoration. The vigour and freedom of the painting and the richness of the colour of some of these made them conspicuous even among so much that was brilliant.

Where no evil influence of bad European taste had been felt, the productions from these factories afforded examples of ornament that in quaintness of fancy, skilful balance of parts, and gorgeous effects of colour could not easily be surpassed.

As examples of ingenious potting may be quoted some of the perforated or open-work exhibited, distinguished by extreme delicacy and equality of line. Perforated ware.

The collections from Kiyoto included porcelain and earthenware: some of the factories also are notable for skill in imitating ancient wares, and the productions of other localities. The porcelain included tea and coffee services in considerable variety, flower and other vases, many of excellent quality and decoration. Some specimens were painted in a bold somewhat grotesque style known as "Topa-ye" from the inventor, a priest who is stated to have lived about 600 years ago in Topa, and thus given a name to this manner of painting, which is at least strongly characterised, whatever may be the date of its origin. Also from Kiyoto came examples of a style of decoration but recently introduced; vases, incense cases, &c. in imitation of bronze inlaid with gold; some also with designs in Indian style, on a dead or mât ground, with flowers in gold, very rich and quiet in effect. The earthenware, chiefly "Avata" ware of a yellowish colour with a good feltspathic glaze, was shown in a great variety of forms, and often minutely and beautifully painted; it commonly goes under the name of Kiyoto ware, and is made in large quantities, being extremely popular in Japan as imitating the style and effect of the old Satsuma ware. Among pieces that were worth noting were a pair of vases 24 in. high, with raised ornament and flowers in full relief round the base; they were very rich in decorative effect: the price of these in Japan would be about 9*l*. In another pair of vases of similar size, painted skilfully with landscape designs, cloisonné enamel had been introduced on both sides with good result. Topa-ye decoration. "Avata" or Kiyoto ware.

In some of the earthenware manufactured at Kiyoto and elsewhere, especially when covered like the celadon with a thick opaque glaze, the body is composed of a coarse clay overlaid with a finer material; this method of manufacture is frequent in Japan, and is applied both to stonewares and faïence.

The "Yeiraku" porcelain is notable for the fine red colour used in its decoration, made from oxide of iron, and first introduced from China by the grandfather of the exhibitor, named Zengoro Yeiraku. This splendid and effective colour is heightened by rich gilding, the ornaments in gold being skilfully designed and etched with much taste. It has been freely imitated by other makers, but a tendency was shown in their works to over-burnish the gold, thinking thus to catch the ill-trained foreign eye. "Yeiraku" porcelain.

The Awaji ware shown, chiefly pieces of not large size, was well potted, and painted with minute and delicate care. It is a pale yellow glazed earthenware, the body soft, the glaze hard; its pleasing tone of colour lends itself well to the light and elegant style of decoration applied to it by the dexterous hand as well as the good taste and judgment of the Japanese artist-potters. "Awaji" ware.

The well-known "Banko" ware, so called after its inventor, was abundantly illustrated; the clays of which it is made are extremely tough, and taking advantage of this quality various colours are worked together—drab, dark brown, reddish, and white—so as to produce a veined or marbled effect somewhat similar to the old "Whieldon" ware made in Staffordshire in the last century. Some of the handles and applied pieces are cleverly perforated. This variegated description is called "Mokume" ware. "Banko" ware. "Mokume" ware.

In some pieces of this "Banko" pottery inscriptions were inlaid in white porcelain clay, the body of the ware being perforated so that the letters delicately written were legible on both sides. This ware, which is often of extreme thinness, is unglazed, but not unfrequently richly and boldly painted in enamel colours. Some peculiar methods of their use are stated to be a specialty of one of the factories at Yokka-ichi in the province of Ise. The descendant of the inventor of the Banko ware exhibited excellent specimens of this pottery. Also from Kawana, province of Ise, Banko ware and the marbled varieties were shown. "Yokka-ichi" ware.

From works quite recently established at Yokohama came a most remarkable and varied collection of porcelain and pottery. Some specimens showed ornaments in relief in biscuit combined with the ordinary coloured and glazed decoration; a remarkable pair of vases had figures in low relief representing the deities of wind and thunder, coloured with great brilliancy; others had flowers in biscuit in full relief, and contained a glazed and decorated vessel enclosed in the interior as a *tour de force* in potting. A process of painting in New works at Yokohama.

Painting in slip. clay-slip, similar to the process known as Pâte-sur-pâte, is used to some extent in these works.

Imitations of Satsuma ware. The imitation of Satsuma ware made here is very successful; especially worth noting was a set of three large pieces, the centre being a "koro" or incense burner, the sides of which were ingeniously recessed to contain figures representing some of the seven deities and their companions—most elaborate and skilful work. Several other pieces also proved the mastery attained over difficult processes. With respect to the painted decoration of these pieces, some of the animals, crabs, &c. were delineated with a graphic vigour and power of seizing salient features which only Japanese artist-potters seem to attain.

aga ware. Kaga ware was well illustrated by various exhibitors; there were at least sixteen distinct factories represented, and some by very considerable collections. Amongst the exhibitors was the Kaga Association for the Encouragement of Manufactures. Tea, coffee, and dinner services were shown; also vases, lamp vases, cake boxes, covered bowls, large tea jars, &c.; among them many specimens of excellent quality in manufacture and decoration.

On the whole the Japanese display of ceramic products was such as to surpass anything that has hitherto been shown by a single country at any previous International Exhibition.

China.

Chinese pottery. The exhibition of porcelain and stoneware from China, especially of the former, was very extensive; much more so than could be fairly displayed in the available space. It mainly consisted of large vases and various decorative pieces, garden seats, flower-vases and tea-wares: also dinner services and other pieces made especially for European use.

Collection from Imperial Customs. The exhibitors were chiefly agents rather than manufacturers. The establishments of the Imperial Customs at Shánghai, at Canton, and at Kin-kiang sent large collections.

Porcelain. The porcelain is for the most part very hard, close and fine in texture, the glaze hard and well incorporated, and the potting skilful, but in design, decoration, and colour there is a manifest falling off from the excellence of the ancient work. Neither were there any pieces which could compete in quality of body and glaze with really fine examples of the work of the 17th century, and perhaps of earlier periods. The bulk of the porcelain exhibited seems to have been made at King-te-Chin, and a considerable proportion of it decorated at Shanghai; the deteriorating influence of bad European taste was unfortunately very observable in the style and general effect of much that was exhibited.

Bad effects of European taste.

"Crackle" china. Specimens of "crackle" china were shown, mostly imitating early pieces, some having, according to a favourite fashion, handles, bands, and bases in imitation of bronze-mounting. There were also examples of imitation crackle, produced by patterns printed from transfer paper; the effect of these is not satisfactory.

Some celadon-grounded vases enriched with blue decoration were shown of good quality, nevertheless wanting in the refinement of effect that has been attained in this combination of colours by Chinese potters of former periods.

Garden seats. Garden seats, long a speciality of Chinese potters, were shown in great numbers; admirably made, of the usual barrel-shaped pattern, constructed in pierced or openwork porcelain of excellent body. The perfection with which these large and very solid pieces are moulded, fired, and glazed speaks well for the manipulative dexterity and the knowledge of Chinese workmen. The decoration on some of these seats was very elegant, and the colours harmonious; a pale yellow enamel was especially successful; a clear blue celadon and purple were also valuable colours.

Vases. Among pieces prominent from their size was a pair of vases 4 feet 6 inches in height, elaborately decorated, and having gilt handle ornaments in relief. These were fine examples of skill in manufacture, but were not successful as decorative works, being greatly wanting in harmony of colour. Another large pair with greenish grey conventional ornament on a pale yellow ground were pleasing in effect. Some bulbed vases about 3 feet high were of the quaint traditional form, and fairly coloured. The largest pair of vases shown were 5 feet high, thoroughly well made, but gaudy and unsatisfactory in colour.

Blue and white porcelain.

The blue and white porcelain exhibited included some fine pieces, but chiefly made in imitation of early models; the drawing, however, upon several of them, especially of birds and flowers, was vigorous and effective, proving that the ancient skill of the artist decorators has not wholly died out.

Imitation fruit.

Boxes and table ornaments in forms of fruit were worth notice for truthful modelling, and in the case of some for excellent colour; the brilliant red of the ripe tomato was wonderfully imitated, this red being one of the colours in which the Chinese potters surpass all rivals.

Stoneware.

The stoneware exhibited consisted for the most part of flower and other ornamental vases, glazed with flowing or splashed opaque glazes of rich colours. Some of these in purple, in plum colour, and in deep red were highly decorative. There is, however, a tendency to apply to these colours a glaze too glittering, and in this respect the modern pieces differ disadvantageously from the ancient examples of similar style.

Of unglazed stoneware were shown some flower-pots of an excellent brown hard-bodied ware, very quaintly and ingeniously designed. These were suggestive and curious pieces; they were shown by an exhibitor from Hong Chow.

Terra-cotta figures.

Some clever terra-cotta figures were included in the collection from Kiukiang, modelled with skill, and having a good deal of quaint character.

In addition to the modern wares exhibited were collections including pieces of early manufacture in porcelain and pottery, some among them being of great interest and considerable value. It is impossible here to do more than allude to them, as descriptions, to be of any value, would require to be minute and elaborate, far beyond what the space at my command would permit.

*Glass.**

Glass.

The exhibition of glass was undoubtedly large and important; nevertheless it did not equal the displays made at some of the International Exhibitions held in Europe. It included within the scope of Group II. (2) all kinds of glass table and household wares, toilet articles, decorative objects, candelabra, lamps, shades, reflectors, and other pieces for lighting apparatus, roofing plates and tiles, paving slabs, mosaics, jars and bottles of all kinds, druggists', perfumers', and other wares; chemical glass; flint and crown glass discs for lenses and other scientific purposes, canes of various coloured glass, beads, woven and spun glass, window glass of all sizes, clear and silvered plate glass—some pieces being of extraordinary dimensions.

Range of wares exhibited.

These various objects, according to their requirements, were either blown, pressed or moulded, cut, engraved, etched, &c., and were of flint, crown, crystal, green, and lime glass metals.

Machine and raw materials.

In addition there were moulds and machines for pressing, &c.; specimens of sand and other materials for making and colours for staining and painting glass. There was besides a working glass-house erected on the grounds, where the whole process of making glass for table use could be seen.

Want of individuality in exhibits from different countries.

It was observed with truth that there was a want of individual or national character in the collections of glass brought together from distant countries. From Bohemia there came glass that might have been made in France or England, and from Edinburgh specimens that might have come from Venice.

Levelling tendencies.

Of late years this levelling tendency in industrial arts has been more and more observable, produced by causes sufficiently obvious; and it seems apt to be forgotten that, whether high or low, it is still a level, and that it is very necessary for great efforts to be made to rise above it.

Ancient Greek glass. Arab glass. Venetian glass.

The ancient Greek glass, however elaborately varied in detail, had strong art-characteristics. The Arab glass of the 14th or 15th centuries owes much of the charm of its richly decorative effect to the marked individuality of its style; the same may in great measure be said of the Venetian glass of the 15th and 16th centuries, the traditions of which continue to retain vitality. In the present day the eagerness to attain success which will rapidly pay in

---

* For a special examination of the collections of glass generally thoughout the Exhibition buildings my thanks are due to my colleague, Dr. Seelhorst, Director of the Industrial Museum, Nuremburg, and for all particulars respecting the manufacture in the United States, I have to thank General Hector Tyndale, to whom my great obligations for other important assistance have been already acknowledged.

the mechanical and industrial processes—the trade part of the manufacture—has in so many instances been the sole influence at work, that servile imitation of the nearest model promising a profit was the utmost that could be looked for from the ordinary factories. Recently, however, a change has begun to be apparent, and efforts to lift the manufacture above a dead level have been made; the work and investigations of the late Mr. Apsley Pellatt and others having materially tended, in England at least, to produce so desirable a result. More especially, however, has it been brought about by the collection and exhibition of fine examples of Greek, Roman, Arab, early Venetian, Dutch, and German glass.

In more than one respect it is satisfactory to note that modern glass surpasses all that preceded it, in perfection of clearness and brilliancy, in fineness and cleanness of cutting, and in the vast size of pieces for lighting, for mirrors, &c.

United States. The exhibition from the United States was a large, varied, and important one from almost every point of view, including, as it did, nearly all descriptions of glass wares.

First factories. Manufactories of glass of the coarser kinds were early established in the States, as early or perhaps earlier than the war of the Revolution, 1776-1783, but no great or marked advance was made until within the first quarter of the present century, during which period "flint" glass works were founded in several parts of the country. These rapidly increased in numbers, until at the present time there are many centres of the glass industry each of which produces large and increasing quantities. The quality also has improved in nearly the same ratio, and while there is much room for amendment in the forms and style, and ample opportunity for the application of art-design, the United States may be congratulated on having a well-founded and established "flint" glass manufacture.

At several points considerable works have been started for the manufacture of plate glass; but as these are yet new, and the productions consequently small, they are but little known except in the vicinities of the works, where in some instances exclusive use is made of them for windows, and, when silvered, for mirror-plates.

„ Lime " glass. Of "lime" glass there were large and interesting collections from the United States. In this description of glass great advances have been made in respect of brilliancy, endurance, and transparency; the wares composed of it are sold very cheaply. On the whole it is evident from the present position of the manufacture that before many years have passed America will compete successfully in all the industrial processes of glass making with any country in the world, and as her manufacturers become more alive to the value of trained artistic skill and taste their productions will doubtless attain before long at least to the level arrived at in Europe.

Great Britain. The collections from Great Britain included some examples of excellent quality, the purity and brilliancy of metal for which English glass has a deserved reputation being well illustrated; in the designs of ornamental objects advance is being made as well as in the forms of wares for household use. A collection chiefly of ornamental glass in the style of old Venetian, but not servilely copied from previous works, received and deserved high commendation.

France. In France very large establishments have been created and great efforts have been made not only by the introduction of improved processes, but also to advance the manufacture from an æsthetic point of view. In the Exhibition it was, however, to be regretted that France was only represented in glass by window plates and mirror glass, and not by ornamental and other wares. Some of the specimens sent were of extraordinary dimensions and of a very high quality.

Germany. From Germany were shown plate glass, mirrors and window glass, including some curious collections of the small and very cheap toy and other mirrors which are produced in that country in such immense quantity as to constitute a considerable industry.

Bohemia. The well-known Bohemian glass was strongly represented. The traditional forms which have been inherited from the 17th and 18th centuries are in many cases with advantage adhered to; the quality of the metal has advanced greatly within the last 13 years, but there is yet great room for improvement in colour and design; combinations of colour are seen which offend the eye as

a false note in music offends the ear, and shapes which are nearly as ugly as is possible to produce in so beautiful a material. On the other hand, many ingenious processes have been invented and successfully applied, so that the cost of production has become greatly reduced and the consequent use of glass for household purposes immensely increased. Among the table wares it was satisfactory to observe not only excellent material but occasionally a judicious use of the splendid colours which are known to the manufacturers; forms also were exhibited both correct and serviceable.

Specimens of the lately introduced lustred glass were shown, a beautiful method of giving additional brilliancy and play of colour to the surface; some of the colours rival the iridescence seen on specimens of ancient Roman glass.

Glass wares of various descriptions were exhibited from Holland, Belgium, Sweden, Norway, Spain, Portugal and Italy, of which the space at my command already overpassed prevents my giving details. **Other European countries.**

The specimens from Italy illustrated very fairly the graceful and elegant forms and the manipulative skill which are traditional in the factories at Murano, and to which fresh impulse has been given within the last few years. **Italy.**

I feel that I cannot conclude this report without briefly expressing the obligations I am under to the colleagues with whom I had the great advantage of being associated in my work. From all I met with an unfailing courtesy, a ready aid and a generous support, so that the responsible duties of chairman of the group were rendered comparatively light and easy instead of being, as might otherwise have happened, a laborious and difficult task.

I have, &c.

R. H. Soden Smith.

APPENDIX.

Extracts from Report upon the Chemistry and Composition of the Porcelains and Porcelain-locks of Japan, by Henry Wurtz, Judge in Group II.; attached also as a Delegate-Judge to Group 1 (as special Examiner of Ceramic Minerals and Materials).

(*Quoted by permission of the author ; see p.* 48.)

The samples of porcelain minerals were selected from the collections on exhibition at Philadelphia, by permission of the Imperial Japanese Commissioners.

The following are the details of Professor Wurtz's analyses :—

Details of the Analyses.

"The minerals selected and submitted to analysis were eight in number, making, together with the two porcelains analysed, ten materials in all, which will be designated by letters of the alphabet :— **Analyses of materials.**

Materials.

A. The Tsuji-chuchi.
B. „ Shiro-chuchi.
C. „ Sakaime-chuchi.
D. „ Uwa-kuszuri-chuchi.
E. „ Indo-chuchi.
F. „ Kudaru-yama-chuchi.
G. „ Sei-ji-chuchi.
H. „ Shira-kawa-chuchi.
J. „ Egg-shell porcelain.
K. „ Thick-body porcelain.

A. *The Tsuji-chuchi.*—This is the most valuable and costly variety of the porcelain-stone found at Idzumi-yama, and forms 70 per cent. of the body **The Tsuji-chuchi.**

General characteristics.

of the finer egg-shell porcelain. It is a dull-white, porous, granular, coherent mass, not very unlike coarse chalk in appearance, but somewhat harder and very much tougher; breaks with difficulty; rough to the touch, smearing the fingers, though not readily; fracture granular, conchoidal, dull; mass obscurely *laminated* (?). It adheres to the tongue, with a chalky taste, and has a distinct odour, much more of a chalky than a clayey character. It crushes grittily between the teeth, not at all with a sandy or quartzose grit, but about like calcite. In the mass, under a low magnifying power, it has almost a saccharoid appearance, composed apparently of small granules, which have a distinct though dull lustre. The aspect suggests homogeneity, which is disproved, however, by the results of the washing and analyses. Splinters are scarcely affected before the blowpipe; but in powder, both the raw and washed mineral are easily fritted fast to a platinum wire in an intense blowpipe jet, becoming translucent. It contains no trace of carbonic dioxide. In boiling water the mass evolves air appreciably. After powdering and igniting it has a pinkish tinge. The proportion of fine powder remaining suspended in water, after pounding and sifting as above specified, was 45 per cent. of the whole mass.

Analysis.

The results of *absolute analysis* of the *washed* (45 per cent. of the) Tsuji-chuchi, after drying over oil of vitriol, were as follows :—

		Computed to 100 parts, without the water.
Combined water	2·518	—
Silica	78·181	80·672
Alumina	15·699	16·174
Ferrous oxide	·663	·684
Lime	None	None
Magnesia	·099	·102
Soda	1·744	1·799
Potash	·551	·569
Manganese	Trace	Trace
	99·430	100·000

Density

Density of the powder analysed, taken with exceeding care and accuracy, at 0° C. = 2·6962. It may in this place be added that two similarly-exact determinations upon two samples of the whole mass of the Tsuji-chuchi, gave 2·6845 and 2·6855.

It yielded to 20 per cent. potash-lye, on three minutes' boiling, but 0·444 per cent. of silica, with 0·333 per cent. of alumina, containing therefore but little amorphous uncombined silica or opal.

Absence of lime.

The entire absence of *lime* from the Tsuji-chuchi is not only in itself remarkable, but bears on the analysis of the egg-shell porcelain below. The fact was settled to be such by repeated and rigid tests. No doubt can remain that this variety—or at least the sample of it exhibited—was exceptionally devoid of lime, having probably been deprived thereof by some natural solvent; and the superior refractory character attributed to this variety might reasonably seem connected with this freedom from lime.

The Shiro-chuchi.

General characteristics.

B. *The Shiro-chuchi.*—This variety is also used in the egg-shell ware, to the extent of thirty per cent. of the *washed* mineral. In the mass it is finer-grained, harder, tougher, and more compact than A, but otherwise quite similar; having an equally white colour and a like chalky taste and odour, adhering to the tongue, and smearing the fingers slightly (when hard rubbed), though without the slightest smooth or unctuous feel. Diffused throughout it are some small dark-coloured specks not present in A. These, under the magnifier, are seen to contain slight nuclear remains of small crystals of iron pyrites. On blowpipe test these specks gave an iron reaction, but no *permanent* colour was imparted to a phosphorus-salt bead in either the oxidizing or reducing flames. The proportion of finer material obtained by the same process of crushing and elutriation was much smaller than in the case of the Tsuji-chuchi, being but twenty-five per cent.; but, except in the presence of a little lime and a little more iron, the composition of this washed portion does not greatly differ from that of A.

The Shiro (like the Tsuji-chuchi), though dull to the eye, shows under the magnifier, on the part of the granules which make up the mass, a distinct degree of *lustre,* scarcely less than that of a fracture of the porcelain itself. The magnified aspect, under low power, is that of some *compact* feldspathic or felsitic *psammites,* though porosity is of course proved by the adhesion to the tongue. Thin splinters appeared to yield slightly before the blowpipe at their thinnest edges, and the powder, on the extremity of a fine platinum wire held axially in the most intense mouth-blowpipe heat (from a stearic acid candle of the best quality) about equal to the point of fusion of platinum, passed into unmistakable transparent blebby fusion, a thing which could not be accomplished in the case of the Tsuji-chuchi. This is entirely in accordance with the statements of the manufacturers, given by Dr. Wagener. That the presence of so small an amount of lime, with the trifling additional percentages of iron and alkali, should produce so perceptible a difference in fusibility, is remarkable, but may not surprise some chemists of special experience. It illustrates well the almost inutility of any but the most refined and *absolutely exact* analyses of materials employed in such arts as the ceramic.

The *absolute analysis* of the washed Shiro-chuchi (softest 25 per cent. of the whole), dried over oil of vitriol, yielded: Analysis.

		Computed to 100 parts, without the water.
Combined water	3·330	—
Silica	77·685	80·920
Alumina	15·189	15·822
Ferrous oxide	·895	·932
Lime	·146	·152
Magnesia	·096	·100
Soda	1·469	1·530
Potash	·508	·530
Manganous oxide	·013	·014
Sulphur	Trace	Trace
	99·331	100·000

Boiling 20 per cent. potash-lye dissolved out 2·769 per cent. of silica and 1·352 per cent. of alumina.

C. *The Sakaime-chuchi.*—This variety is used, with the Shiro-chuchi, in compounding the body of the thicker and commoner porcelains. There is little in its appearance to distinguish it, either by the eye or the magnifier, from the Shiro-chuchi, except possibly less hardness and a little coarser grain. Except that no specks of pyrites were discovered in it, the description of its characters, and behaviour before the blowpipe, would be substantially similar to that given above of the Shiro-chuchi. It evolves, when boiled in water, a little air, and with hot nitric acid minute traces of carbonic dioxide. The amount of the softer portion obtained by elutriation was 30 per cent. After ignition and grinding, the powder had a feeble pinkish tinge. *Absolute analysis* of the finer 30 per cent., dried over oil of vitriol, gave: The Sakaime-chuchi. General characteristics. Analysis.

		Computed to 100 parts, without the water.
Combined water	3·320	—
Silica	78·073	81·141
Alumina	13·993	14·542
Ferrous oxide	1·020	1·060
Lime	·186	·196
Magnesia	·229	·242
Soda	1·722	1·789
Potash	·961	·999
Manganous oxide	·031	·031
	99·545	100·000

Density, taken at 0° C., with great care, was found to be 2·6041—lower, to a remarkable degree, than that of the washed Tsuji-chuchi. The difference is Density.

too large to be attributable to the small additional amount of water, and must be due also to essential molecular variation.

Boiling 20 per cent. potash-lye dissolved, of silica, 2·887 per cent.; of alumina, 1·428 per cent.

Analysis.

An isolated analysis of the *whole mass* gave:

		Without water.
Combined water	2·610	—
Silica	78·922	81·314
Alumina	14·373	14·809
Ferric oxide	·868	·894
Lime	·162	·167
Magnesia	·224	·232
Soda, Potash	2·463	2·539
Manganous oxide	·044	·045
Carbonic dioxide	Trace	Trace
Sulphur	Trace	Trace
	99·666	100·000

From these analyses it would seem that the washed product differs very little from the whole mass, a fact which was found to hold with others of these minerals.

The Uwa-kus-zuri-chuchi. General characteristics.

D. *The Uwa-kuszuri-chuchi.*—This variety is used in compounding *glazes*, in admixture with lixiviated wood-ashes. It differs from the preceding varieties in being softer, smearing the fingers readily (without any clay-like smoothness, however), and it has throughout a good many dark specks, accompanied by points of iron pyrites visible under the lens. In other respects its general description resembles the preceding companion-minerals. After ignition and grinding, the powder was pale pinkish. Elutriation yielded thirty-five per cent. of the mass. The absolute analysis of this, dried over oil of vitriol, gave:

Analysis.

		Computed to 100 parts, without the water.
Combined water	3·715	—
Silica	78·210	81·772
Alumina	14·407	15·059
Ferrous oxide	1·408	1·471
Lime	·097	·102
Magnesia	None	None
Soda	1·385	1·447
Potash	·142	·149
Sulphur	Trace	Trace
	99·464	100·000

Boiling potash-lye, 20 per cent., dissolved from the washed mineral 1·969 per cent. of silica and 1·709 per cent. of alumina.

Of the *whole mass* of this variety, but a partial analysis was completed, which gave:

Combined water	2·91
Silica	81·33
Alumina	13·01

The Indo-chuchi.

E. *The Indo-chuchi.*—A great interest attaches to this variety, from the fact, as stated by Dr. Wagener in his letters, that it still retains, in admixture, some of the unaltered mineral, from which he conceives all the four preceding kinds, together with the one which comes next (F.), to have been derived, by unknown processes of alteration. It presents a coarse-grained mass, rather irregular in texture, colour, fracture, and degree of porosity. In some places it is quite white, in others much stained with limonite. Scraping with a knife at once distinguishes some harder parts, or flakes, dispersed irregularly throughout the mass. With great labour, a considerable quantity of this harder material was dissected out, and crushed to coarse powder, in order to remove the remainder of the soft portions adherent; which was accomplished by grinding in a

General characteristics.

mortar with water, with a light pressure, so long as the water became at all milky. A coarse sand-like material was thus obtained having fully the hardness of unaltered feldspar. Under the magnifier this presented the appearance of angular, opaque, milk-white fragments, conchoidal, and dull. No traces of feldspathic cleavages. Some grains showed what appeared like encrusted, or possibly corroded surfaces, a little honey-combed and lustrous, which may indicate alteration. On ignition of these grains, they first *blacken* somewhat, apparently from presence of organic matter, but quickly burn white again. This behaviour is very curious, differing from that of any of the associated minerals. No very marked odour accompanies this blackening, but the water given off has a distinct *acid* reaction, due very likely to sulphurous acid; so that the blackening may be due to the co-existence of a trace of sulphuric acid or an acid sulphate with organic matter. Another curious fact about this Indo-chuchi was the development of a distinct *musk-like* odour from it when warm. After ignition most of the grains had assumed a reddish ferruginous tinge, some few, however, remaining white. The total iron in the mass, nevertheless, as shown by the analysis, is surprisingly small, being evidently also in *ferrous* form. The *absolute analysis* of these hard rains, dried at 100° C. for many hours, gave:

Analysis.

		Computed to 100 parts, without the water.
Combined water	1·155	—
Silica	82·292	83·698
Alumina	11·981	12·186
Ferrous oxide	·139	·141
Lime	·287	·291
Magnesia	·064	·064
Soda	2·981	3·032
Potash	·506	·515
Manganous oxide	·072	·073
	99·477	100·000

Density, taken with great care, upon the sand-like mass, at 0° C. = 2·489. Density.
Two sediments, obtained successively (as below) from the liquid poured off from this, yielded the densities 2·6032 and 2·5769, the more altered portions of the rock being therefore very much denser. The fact that the second sediment was lighter than the first, is attributable, in part at least, to a higher degree of *hydratation*.

By boiling 20 per cent. potash-lye, there was dissolved from this mineral—of silica, 6·587 per cent., present doubtless in opaline form; of alumina, not a trace.

The above analysis (after deducting the *opal* present) may be well represented by the following empirical formula:

$O^{61}.Si^{22}Al^{4}Na^{2}.H^{2}O$. Density (computed) at 0° = 2·533.

In washing out the above hard—supposed unaltered—Indo-chuchi, the milky water, after separation of all the coarser heavy sediment, was saved, and allowed to stand for one hour, when a fine sandy sediment had separated from it. It is thought that an examination of this will be of much interest, to compare with the harder (or at least tougher) portion of the mass whose composition is above given. Up to the time of closing this report, however, only its *density* can be given, which was found to be, at 0° C., 2·6032—considerably higher, therefore, than that of the coarser portion. Further, on standing for six days, the milky liquid poured off from the last had again deposited quite a large quantity of fine mud; and finally, the same liquid, again on adding—to coagulate the suspended matter—$\frac{1}{400}$ of its weight of *chloride of calcium*, became entirely clear in a few hours, with separation of a small white precipitate.* All these products are in process of examination, and the results

* It may be of interest here to note the curious fact, encountered in reading the memoir of Ebelmen and Salvétat (referred to in a subsequent paragraph), that the *Chinese* porcelain-makers have long been acquainted, *practically*, with the circumstance here made use of, the power of soluble salts (particularly those of lime) to coagulate and precipitate suspended slimy mineral matters from water; which has been supposed by some to be a quite recent discovery, claimed by several chemists. E. and S. received, with their other minerals from King-te-tching, one called "Chy-kao," stated to have this precipitating power. Their analysis showed this mineral to be simply a fibrous variety of gypsum or lime-sulphate.

will be highly interesting; but some months must elapse before these results can be fully elaborated for publication, together with similar investigations in progress upon some of the other minerals of the group.

The Kudaru-yama-chuchi.

F. *The Kudaru-yama-chuchi.*—This is the variety also called Kesso-chuchi. It is, like the last, of especial interest, for several reasons, one of which is that this is the only variety presenting any approach, even in aspect, to a *clay*. Other reasons will appear in discussing the porcelain analyses.

General characteristics.

It is a pure white, soft, chalk-like substance, easily rubbed up between the fingers, with a *slightly* unctuous feel, but quite inferior in this latter respect to a true clay. Under the magnifier it appears to be made up of *very small* amorphous, transparent grains, irregular in size. In water it immediately falls to powder with effervescence (from escape of air), but the paste formed has very little of the plasticity of that formed by true clays. It is chalk-like in odour, like the other minerals of the group; and shows no grittiness between the teeth. Even after ignition, and notwithstanding its very appreciable proportion of iron, its colour remains pure white. Like all the other related minerals, it may, when in powder be fritted fast to a fine platinum wire by the intensest heat of the mouth-blowpipe, though possibly with more difficulty than the others. Two analyses were made, one an isolated analysis of the whole mass, the other an absolute analysis of a portion obtained by washing over in suspension in water and drying over oil of vitrol, which portion amounted to 44·8 per cent. of the mass.

Analysis.

Absolute analysis of the latter yielded:

		Computed to 100 parts, without the water.
Combined water	7·607	—
Silica	49·931	54·072
Alumina	38·738	41·951
Ferrous oxide	1·582	1·713
Lime	None	None
Magnesia	·206	·223
Soda	1·445	1·565
Potash	·440	·476
	99·949	100·000

Density.

Density carefully determined at the temperature of melting ice, or 0° C. = 2·627.

By boiling 20 per cent. potash-lye, there was dissolved from this 4·205 per cent. of silica, with but a trace of alumina, from which must be inferred the presence of a corresponding amount of soluble or opaline silica. Assuming the composition of the latter to be 95· silica, and 5· water, and its density at 0° C. to be 2·09, the composition of pure *kudaruyamite*,* deducting the *opal*, becomes essentially:

Analysis.

		or
Combined water	7·39	7·79
Silica	45·51	47·95
Alumina	38·74	40·82
Ferrous oxide	1·58	1·67
Soda	1·68	1·77
	94·90	100·00

Density of the pure kudaruyamite, as computed at 0° C., = 2·653.

Similarity to the pinites.

This is the composition of a *pinite*, by the nomenclature of Dana; and kudaruyamite is therefore to be regarded as a variety of the pinites, looked on by Genth as amorphous *damourites*. The main peculiarity of kudaruyamite is, that whereas the pinites and damourites are invariably potash-minerals, this variety contains soda instead; and the alkali is, moreover, in much less proportion than in other pinites. Genth, however, regards the *paragonite*-

* It is merely provisionally and for convenience that I coin this and other like names, by adding to the Japanese words for these minerals the usual mineralogical termination *ite*, instead of *chuchi*, which latter is harder to write and pronounce.—H. W.

schists (which are matrices of *corundum*) of St. Gothard, Pregatten in Tyrol, and Ochsenkopf in Saxony, as *sodium-damourite;* but, although pure kudaruyamite has nearly the composition of the micaceous paragonite, by some of the analyses of the latter (containing, however, more water and much less soda), it could not be regarded as paragonite, from its lack of many of the necessary characters. Paragonite-densities range as high as 2·895 (Œllacher), a variation from kudaruyamite sufficient in amount to indicate a variation in *volumic type*, such as cannot here, however, be fully explained. *Margarodite* is another variety; also micaceous, to which kudaruyamite approaches closely in percentage composition. We must be satisfied, for the present, with having accomplished the highly important point of identification of kudaruyamite as a member of Dana's *pinite group* of products of alteration. Further light may come when a complete study—now in progress—shall have been made of the *molecular volumic relations* of this and the other minerals of the locality.

The other (isolated) analysis made of the whole mass of the kudaru-yama-chuchi was as follows: Analysis.

		Computed to 100 parts, without the water.
Combined water	7·57	—
Silica	48·65	53·24
Alumina	38·05	41·64
Ferrous oxide	2·37	2·59
Lime	None	—
Magnesia	·43	·47
Soda, Potash	1·88	2·06
	98·95	100·00

The coarser portion of the kudaru-yama-chuchi, 55·2 per cent. of the whole mass, gave at 0° C. the density 2·6209, slightly less than the washed portion.

G. *The Sei-ji-chuchi.*—This one, as stated by Dr. Wagener, is not a companion-mineral of the preceding six, not coming from the Idzumi-yama quarries, but from some other place in the neighbouring country. The analysis was not therefore made by the *absolute* method. Like D, it is used as a glaze-constituent, for a peculiar green glaze. Its grain is much coarser and rougher than that of the preceding minerals, and it is very distinctly *laminated* in structure. It has, in fact, the aspect of a somewhat altered *feldspathic psammite*, being in all, except colour, not unlike some of the finer-grained varieties of our triassic (?) albitic psammites of the *Palisade Range* (so called "brown or red sandstones," used for building purposes). Though generally white, it is considerably stained by limonite in many places. It adheres to the tongue, though not so much as the Idzumi-yama minerals, and has the same peculiar chalky odour. The analysis gave:

The Sei-ji-chuchi.

General characteristics.

Analysis.

		Computed to 100 parts, without the water.
Combined water	1·297	—
Silica	77·844	80·101
Alumina	13·510	13·901
Ferrous oxide	1·530	1·574
Lime	None	None
Magnesia	·307	·316
Soda, Potash	3·993	4·108
	98·481	100·000

It is evidently related in composition to the Idzumi-yama group of minerals.

H. *The Shira-kawa-chuchi.*—This mineral—also, like the last, not from Idzumi-yama—is used in admixture with B and C in making the peculiar The Shira-kawa-chuchi.

General characteristics.

glaze for the "craquelé" ware. It is white, with brownish bands and stains, finer-grained than G, but coarser than the Idzumi-yama group, porous, rough to touch, but smearing slightly, adhering to tongue, with the chalky odour and taste. Had a feeble flesh-colour in powder after ignition. Isolated analysis of whole mass:

Analysis.

Combined water	·91
Silica	79·13
Alumina	16·44
Ferrous oxide	1·28
Lime	None
Magnesia	·24
Soda } Potash }	1·49
Manganous oxide	·15
	99·64

The two Porcelain-bodies.

J. and K. *The Two Porcelain-bodies.*—The mode of preparation of these for analysis has been before explained. The following table gives the figures obtained by *absolute analysis*, with the specifications of component parts as imparted to Dr. Wagener by the manufacturers:

Analyses.

	Egg-shell ware, containing: washed Tsuji-chuchi, 70 p. c.; washed Shiro-chuchi, 30 p. c.	Thick-body porcelain, containing: washed Shiro-chuchi, 50 p. c.; washed Sakaime-chuchi, 50 p. c.
Silica	78·763	74·545
Alumina	17·847	19·315
Ferrous oxide	·638	1·916
Lime	·213	·106
Magnesia	·029	·176
Soda	1·975	2·832
Potash	·203	·566
	99·668	99·556
Densities, at 0° C.	2·3367	2·3079

Examination of these figures, and comparison of them with the analyses of the washed minerals, shows that while the correspondence in the case of the egg-shell body is quite close enough to verify the formula given by the makers, in the case of the common porcelain there is quite a marked and decided departure from the composition that should follow from the specified mixture of components. Whether this discrepancy is due to variations in the composition of the Shiro- and Sakaime-chuchi (variations by no means improbable*), or to some other cause, it seems almost useless under existing circumstances to conjecture. The deficiency of silica and excess of alumina in the thick-body ware over the minerals stated to enter into it, appears too large to be accounted for by the mere coating of Kudaru-yama-chuchi, which is given before glazing; but this may nevertheless have had *some* influence. We must rest satisfied with the important verification presented by the analysis of the finer egg-shell ware, of the surprising fact that Japan porcelain, excelling all others, in important characteristics regarded as normal for porcelain *par excellence*, is made without the use of *kaolin* at all, or of any equivalent therefor; being compounded, as to its body, solely of petuntse-like or "petrosilicious" minerals. Indeed, the traditional principle—so often repeated in the literature of the art, as a proverb of the Chinese—that while "the petuntse constitutes "the *flesh* of porcelain, kaolin must form its *bones*," is proved here to be altogether inapplicable. It may be also submitted that a common popular belief regarding Oriental porcelain in general—which appears to have been altogether accepted since the celebrated memoir of Ebelmen and Salvétat was

Absence of *kaolin* in Japanese porcelain.

* Thus, the sample of egg-shell ware analyzed contains a quite appreciable amount of *lime*, more than found in the Shiro-chuchi, while in its other component mineral, the Tsuji-chuchi, no lime at all was found.

published, about 1850*—that no essential technological differences exist between European and Oriental porcelain fabrication, should no longer be so implicitly accepted. As an example, Liebig and Kopp's *Jahresbericht der Chemie, etc.* of 1850 (p. 643) says that "Salvétat and Ebelmen's results "furnish the conclusion—in the highest degree interesting to civilization— "that the *Chinese* porcelain industry, as regards the raw materials, the pre- "paration of the mass, and the glazing of the wares, wholly corresponds "with that of Europe." This interpretation of Ebelmen and Salvétat's results—which has been generally extended, in popular belief, to all Oriental porcelain—is really not fairly justifiable, in the opinion of the writer, by an examination of the original memoir of E. and S.; even with reference to the Chinese porcelain of King-te-tching (which, with a large assortment of the raw materials used in that huge assemblage of porcelain-works, constituted the subjects of their research). These chemists, among other minerals, give analyses of a large number of "petrosilicious" minerals from King-te-tching, approximating to each other closely in composition, the average of which may be stated as follows: Average analysis of "petrosilicious" minerals.

		In 100, without water.
Combined water	3·	—
Silica	75·	78·13
Alumina	14·	14·58
Soda	4·	4·17
Potash	3·	3·12
	99·	100·00

with small amounts of iron, lime, magnesia, and sometimes manganese. The close resemblance to the Idzumi-yama minerals, except in the larger proportion of alkalies, is evident. In Ebelmen and Salvétat's memoir there appears no evidence that Chinese porcelain-bodies may not sometimes be *made up* of the above-mentioned petrosilicious minerals, with little or no admixture; while among the actual analyses of Chinese porcelain-bodies on record, several may be cited that approximate well to these minerals in composition. Thus Salvétat himself, in his *Leçons de Céramique,* vol. ii., p. 374, cites one such of a Chinese porcelain; and Laurent and Malaguti obtained, from the body of a white Chinese porcelain vase, figures not very wide of a felsite or petrosilex. Also some among the European porcelains have somewhat like compositions. European porcelains, however, as well as some of the Oriental, differ from the Japan wares in being *much more aluminous,* from the use of kaolin as a constituent, being hence also more refractory than the Chinese, as was remarked by Ebelmen and Salvétat.

The writer believes that he is at least justified in urging that the generally accepted belief regarding the modes of compounding the *Chinese* wares should be suspended until it can be re-considered in the light of further information and chemical examination—when opportunity may occur—of proper samples.

In this connection it will be interesting to quote also (from Stanislaus Julien's work, in a note by Salvétat) an analysis of a sample of "*terre à porcelaine du Japon,*" by Malaguti, as follows: Analysis Malaguti.

Silica	75·9
Alumina	20·0
Lime	·6
Potash	3·5
	100·0

Salvétat remarks upon this that it "is a petrosilex," and further that "it probably represents only *la composition de l'élément fusible,*" a conjecture which readers of this present report may probably not accept readily. This might almost have been one of the Idzumi-yama minerals, though the presence of potash instead of soda throws much doubt upon this supposition.

* *Annales de Chimie et de Physique* (3), xxxi., 237, and xxxv., 312.

It is well known, from statements, and from copies of native Chinese pictures, given in Stanislaus Julien's work, that the Chinese pe-tunt-tse, or petrosilex, is not used in the raw state, but goes through operations of pounding and flotation precisely similar to those applied to the Idzumi-yama minerals of Japan. The products thus obtained pass into Chinese commerce, as concreted again into the form of bricks. Ebelmen and Salvétat give, in their memoir before referred to, analyses of one of these materials, called Yeou-ko, stated to be used at King-te-tching as an ingredient of glazes, in admixture with lime and ashes—which will be quoted, not only because they analysed both the raw and the washed mineral, but because they determined the *density* of the former also. They describe the raw Yeou-ko as a slightly greenish rock, scaly in fracture, and containing minute pyritous cubes disseminated. It fused before the blowpipe to a white enamel. The analyses gave:

Chinese material, "Yeou-ko."

Analyses.

	Raw Mineral.	Washed Mineral.
Combined water	2·7	2·3
Silica	75·9	75·9
Alumina	13·9	14·2
Iron oxide	·7	·8
Lime	·4	·5
Magnesia	Traces	Traces
Soda	3·8	3·5
Potash	2·9	2·8
Manganous oxide	Traces	0·3
	100·3	100·3

Density.

Density, 2·62.

The washed Yeou-ko, which is evidently substantially identical, excluding some small impurities, with the raw mineral, may be closely expressed by the following empirical formula:

$$O^{147}Si^{60}Al^{14}FeNa^{8}K^{2}.6H^{2}O.$$

This is given for comparison with an empirical formula similarly deduced from the washed portions of the Shiro- and Sakaime-chuchi above, the soluble silica in the latter having been computed out and eliminated, as *opal*. Provisionally, we may call this variety *shirolite*.

$$O^{146}Si^{61}Al^{14}FeNa^{4}.8H^{2}O.$$

The egg-shell body may be approximated to a like empirical constitutional type, thus:

$$O^{146}Si^{60}Al^{16}Na^{4};$$

and the thick body also, as

$$O^{150}Si^{60}Al^{18}Na^{6}.$$

As one more example, the purified, washed Tsuji-chuchi, which forms 70 per cent. of the egg-shell body, may be brought to a like relation, differing from *shirolite* by $2(SiO^2H^2O)$; thus—

$$O^{142}Si^{59}Al^{14}FeNa^{4}.6H^{2}O.$$

No intrinsic importance is attached to these empirical formulations, *per se*. They are merely interesting and convenient, as representing equivalent relations."

(*The above extracts are taken from advance sheets supplied to me by the courtesy of Professor Wurtz.* R. H. S. S.)

Dr. WILLIAM ODLING, F.R.S.

CHEMICAL PRODUCTS.

REPORT of WILLIAM ODLING, Esq., M.B., F.R.S., Professor of Chemistry at the University of Oxford, on the display of "CHEMICAL PRODUCTS," (Group III.), at the Centennial Exhibition held in Philadelphia in the Year 1876.

The following gentlemen also were appointed Judges in this Group, the reporter (Dr. Odling) acting as Secretary:—

Professor J. Lawrence Smith, President, Louisville, Ky.
„ C. A. Joy, Columbia College, N.Y.
„ F. A. Genth, University of Pennsylvania, Philadelphia.
„ C. F. Chandler, Columbia College, N.Y.
„ J. W. Mallet, University of Virginia, Charlottesville, Va.
Dr. Rudolph von Wagner, Germany.
M. F. Kuhlman (fils), France.
M. Prosper de Wilde, Belgium.
Signor Emmanuelo Paterno, Italy.

Character and novelty of products.

The development of the chemical arts, as illustrated by the display of chemical products at the Philadelphia Exhibition, is shown alike by the superior quality of the products furnished by long established processes, by the more extended use of processes of recent establishment, and by the introduction of altogether novel processes and products of manufacture. As regards the general excellence in quality of the chemicals exhibited, reference might be made to special products of various kinds; and, more generally, to the collections of pharmaceutical chemicals exhibited chiefly by American manufacturers; to the collections of more or less rare chemicals, organic and inorganic, exhibited chiefly by German manufacturers; to the collections of artificial dye products, exhibited chiefly by French and German manufacturers; to the collections of mineral-oil products, exhibited chiefly by American, German, English, and Canadian manufacturers; and to the collections of primary chemicals, products for the most part of what are known indifferently as chemical works or alkali works, exhibited chiefly by English manufacturers.

Objects of alkali manufacture.

The prime object of the alkali manufacture is the production of carbonate of soda in its different commercial forms, more especially in the form known as soda ash, together with the production of caustic soda, formerly always obtained from soda ash in the state of solution or lye by the consumer himself, but of late years produced in the solid state, and with great economical advantage, as a regular part of the alkali manufacture. Now both carbonate of soda and caustic soda are extracted directly from an intermediate product known as ball soda. This ball soda is got by heating salt-cake, or dry sulphate of soda, with coal and limestone, the salt-cake being got by the action of sulphuric acid on common salt, and the sulphuric acid itself being got by the combustion, under special conditions, of iron pyrites.

Usual course of operations.

The chief raw materials required for the production of soda, both carbonated and caustic, are, accordingly, coal, limestone, common salt, and iron pyrites. But in the combustion of the pyrites to furnish sulphuric acid there is left a residue of burnt pyrites, formerly a waste product but now used up in furnishing metallic silver, metallic copper, and marketable iron oxide. Again, in the formation of salt-cake from sulphuric acid and common salt, there is production also of muriatic acid, formerly in large measure a waste product but now used up in acting on native manganese-oxide to furnish chlorine gas, which is absorbed under different conditions by lime and potash to form bleaching powder and chlorate of potash respectively. But in the action of muriatic acid on manganese-oxide to furnish chlorine there is production also of chloride of manganese, formerly a waste product but now used up in refurnishing manganese-oxide, whereby nowadays the use of the native mineral is reduced to a mere fraction of the entire use of manganese at chemical works. Lastly, by the extraction of the crude soda, caustic and carbonated, from the ball soda, an abundant material is left known as soda-waste, which still constitutes for the most part a waste product, but is made use of at some

works as a source of sulphur, and at others of hyposulphite of soda or antichlore. In this way the production and sale of each of the principal products of the alkali manufacture—that is to say, of carbonate of soda and caustic soda, of the sulphuric and muriatic acids, of sulphate of soda or salt-cake, and of chloride of lime or bleaching powder—are more or less dependent on and regulated by the demand for their several associated products of manufacture. Excellent commercial products of the ordinary course of alkali manufacture are exhibited by several Lancashire and Newcastle firms.

Hargreave's salt-cake process.

The only process of recent introduction connected with the ordinary course of alkali manufacture, and illustrated at the Philadelphia Exhibition, is the process of salt-cake formation according to the patent of Hargreaves. Heretofore salt-cake has been made by acting on common salt with sulphuric acid under the influence at first of a gentle, afterwards of a stronger heat. For the production of the necessary sulphuric acid, the sulphurous oxide gas furnished by the combustion of pyrites is received in enormous leaden chambers where by the joint action of air, steam, and specially produced nitrous fumes, it is converted into aqueous sulphuric acid of sufficient strength to react with common salt as above described. According to Hargreaves' process, however, the sulphurous oxide gas produced by the burning of the pyrites, together with excess of more or less moist air, is passed at once over heated common salt, whereby salt-cake and muriatic acid are produced as in the older process, the prior and separate conversion of the sulphurous oxide gas into sulphuric acid by means of air and moisture, aided by the presence also of the nitrous fumes, being dispensed with altogether. Independently of its economic importance the process is of great scientific interest. The conditions of its success are, however, better made out in practice than understood in theory. Salt-cake of high quality, manufactured by this process, is exhibited by the Runcorn Alkali Company, Limited (England).

Soda production by Solvay's process.

An entirely different method of alkali manufacture, also of comparatively recent introduction, and illustrated at the Exhibition, is Solvay's process of obtaining carbonate of soda direct from brine. The brine, as pumped from the salt mines, after its purification by treatment in succession with lime water and a little carbonate of ammonia, is saturated with ammonia gas, obtained in the first instance from gas-liquor. The ammoniacal liquid is then subjected to the action of carbonic acid gas injected under considerable pressure, whereby bicarbonate of soda is deposited and sal-ammoniac left in solution. The deposited soda-salt is collected, washed, and ignited, whereby it yields a soda ash of high strength and purity. The sal-ammoniac solution is distilled with lime, and the ammonia gas thereby evolved condensed in a fresh portion of purified brine, and so on continuously, gas-liquor being resorted to as a source of ammonia only in the first instance, and to compensate for accidental but unavoidable loss in the process. It is observable that this process consists substantially in the conversion of limestone and common salt into carbonate of soda and chloride of calcium, the ammonia constituting, so to speak, merely the apparatus of conversion, and no other product of value except carbonate of soda being obtained. Samples of soda ash, purified bicarbonate of soda, &c., furnished by this process are exhibited by Messrs. Solvay and Co. (Belgium); Messrs. Brunner, Mond, and Co. (England), who have introduced some useful modifications in the general conduct of the process; by Messrs. Richards, Kearne, and Gascoine (England); and by M. Honigmann (Germany).

Extraction of soda and alumina from cryolite.

Yet another altogether different method of alkali production is illustrated by the exhibition of the Pennsylvania Salt Manufacturing Company (United States). The basis of this manufacture is the rocky mineral known as cryolite, which is a double fluoride of aluminum and sodium. This material, having been finely ground, is fritted with lime, whereby it is decomposed, so as to furnish insoluble and practically valueless fluoride of calcium, together with alumina and soda capable of extraction by water. By treatment of the watery solution with carbonic acid gas there is produced a precipitate of alumina, highly valuable for the manufacture of alum-cake and ordinary alum; while carbonate of soda is obtained by subsequent evaporation of the solution. It is observable that the production of carbonate of soda by this process is necessarily regulated to some extent by the demand for aluminous compounds, also produced and exhibited in their usual commercial forms by the Penn-

sylvania Company. Alum, both crystalline and in other forms, more especially in a crude form suitable for the precipitation of sewage, &c., is exhibited also by the firm of P. Spence & Co. (England).

Second only in importance, among purely chemical manufactures, to the alkali industry is the industry of coal-tar, yielding more especially coal-tar dyes and coal-tar antiseptics. In addition to many minor but not unimportant novelties connected with this branch of chemical industry attention may be specially directed to the development of the artificial production of the madder dyes, alizarine and purpurine; to the practice as a manufacturing operation of Kolbe's process for the artificial production of salicylic acid; and to the introduction, by Baeyer, of a new dye-product, eosine, evidently one of a class of compounds not less interesting in a scientific than likely to prove important in an industrial point of view. **The coal-tar industry.**

Coal-tar, as obtained from gasworks, is heated over the open fire in stills often holding as much as 2,000 gallons or so. The principal products of the distillation are 1, coal-tar naphtha; 2, kreasote oil; 3, anthracene oil; and 4, the residue of pitch; each product amounting roughly to about one-fourth, more or less, of the original quantity of tar. The distillation constitutes usually a daily operation, the retorts being charged early in the morning and the pitch being run off in the afternoon or evening. From the naphtha is produced aniline, and the whole series of aniline colours. By rectification of the naphtha there is obtained a product known as toluene B. P. 111° C., which by treatment at a boiling heat with chlorine yields a compound known as benzylene dichloride B. P. 206° C., which distilled with alkali is found to yield essential oil of bitter almonds. A specimen of bitter almond oil amounting to some gallons, produced artificially by this process, is exhibited by Wilhelmi (Germany). **Distillation of coal-tar.**

The usual course of production of the principal aniline colours is briefly as follows:—Rectified coal-tar naphtha, consisting mainly of benzol and toluol, is acted on by nitric acid so as to furnish commercial nitrobenzol. This highly oxidised compound is next reduced by means of iron-turnings and acetic acid into aniline. This reduced aniline is then oxidised, usually by means of arsenic acid, whereby crude aniline-red is produced, which is afterwards subjected to various processes of purification. Purified aniline-red is the crystalline salt—usually the acetate or hydrochloride—of a base known as rosaniline. The acetate of rosaniline, heated with aniline, is converted into phenylated rosaniline or aniline-blue. Rosaniline itself, heated with the iodide of ethyl or methyl, is converted into the ethylated or methylated rosanilines known as Hofmann's violets. And lastly, by combination of the base of the violet with more iodide of ethyl, or methyl, so as to form, for instance, a methyl-iodide of the fully methylated base, there is production of aniline-green. **Aniline-colour production.**

The principal improvements in the above course of manufacture, illustrated at the Philadelphia Exhibition, consist in an improved method (Coupier's) of making aniline-red without the use of arsenic acid; an improved method of making the Hofmann violets without the use of iodine; and lastly a mode of converting the base of those violets into aniline-green, also without the use of iodine. In Coupier's process for the production of aniline-red, aniline, itself a deoxidation product of nitrobenzol, instead of being re-oxidised by means of arsenic acid, is simply heated with some additional nitrobenzol, whereby both reagents are converted into the red, the one by oxidation and the other, in effect, by reduction. For the success of the reaction, however, the presence of a small proportion of chloride of iron appears to be essential, the aniline-red resulting actually from a continuous oxidation of the aniline by the iron perchloride, and this reagent being continually re-oxidised by means of the nitrobenzol, thereby reduced to aniline. Magnificent series of aniline-reds produced by this method are exhibited by A. Poirrier (France), and by the Berlin Aniline Manufacturing Company (Germany). The process is indeed recommended as much by the high quality of the products which it yields as by the economy of its working, and by sanitary considerations. **Novel processes of manufacture.**

The original process of producing Hofmann violets consisted in oxidising aniline into aniline-red, and then introducing methyl or ethyl by means of their respective iodides. The new process, elaborated and brought at length to a commercial success by the enterprise of the firm of A. Poirrier, with the **Paris violets and aniline green.**

scientific co-operation of MM. Lauth and Bardy, consists in first introducing methyl by heating a salt of aniline under pressure with methylic alcohol, as in Berthelot's laboratory reaction, and in then oxidising the methylated product, usually by means of chloride of copper. The very beautiful products obtained in this way are known familiarly as Paris violets. The base of the Paris violet, heated with iodide of methyl, was found to yield aniline-green with great facility, but the firm of A. Poirrier, aided by the ingenuity of their chemist, M. Baubigny, has further succeeded in producing this green without any use of iodine whatever. The new process consists in heating Paris violets, plus sufficient lime to set free the base, with a mixture of methylic alcohol and methylic nitrate, so as to furnish the methyl-nitrate of methylated rosaniline, familiarly known as candle-light green. In addition to the houses above referred to, very fine collections of aniline dye-products are exhibited by the Frankfort Aniline Colour Establishment (Germany), by Bindschedler and Busch (Switzerland), by F. Bayer & Co. (Germany), as well as by some other firms. Among minor matters of novelty connected with aniline colours may be mentioned the introduction, by Blackwood and Co. (England), of aniline-black under the name of jetoline, as a most excellent marking-ink for linen, &c., a very minute proportion of some vanadium salt being used to effect the transformation brought about on the large scale by the free employment usually of a salt of copper.

Carbolic acid products.

By treatment of the portion of kreasote oil coming over next after the naphtha there are dissolved out certain feebly acidulous compounds, which are again set free in the form of a heavy oil on acidification of the alkaline liquid. By purification and rectification of this oil there are produced the compounds known in commerce as the carbolic and cresylic acids. The finest display of these compounds is by the firm F. C. Calvert & Co. (England). Both carbolic and cresylic acid, in different forms, are largely used as antiseptics. Carbolic acid is further noticeable as the source of at least three other important products. One of these is the valuable yellow dye known as picric acid, obtained by careful treatment of carbolic acid with nitric acid. It occurs in the form of pale yellow scaly crystals. The salts of this acid, more especially the picrate of ammonia, are used to a considerable extent as explosive agents. Another carbolic acid product is the orange-red colouring matter, known as aurine or coralline, and sometimes as rosolic acid. This is obtained by heating carbolic acid with oxalic acid and sulphuric acid. It occurs in dull red resinous masses, or, when more highly purified, in aggregations of minute crystals. Fine specimens of both the above carbolic acid dye-products are shown by very many exhibitors.

Artificially formed salicylic acid.

A third carbolic acid product is the artificially produced salicylic acid already referred to. Salicylic acid has heretofore been obtained from various salicic compounds, as the crystalline bitter principle of willow bark, and the essential oil of meadow-sweet, and more especially, by saponification, from the essential oil of winter-green. A characteristic property of this acid had been shown to be its decomposition by a moderate heat into carbolic acid and carbonic acid gas; and, conversely, it was shown some years back by Kolbe that salicylic acid might be produced artificially by heating the product of the action of metallic sodium on carbolic acid with carbonic acid gas. Latterly, Kolbe has further shown that when carbolate of soda, obtained by the combination of carbolic acid and caustic soda, is made perfectly dry and heated to 180° C. in a current of carbonic acid gas, one half of the original carbolic acid distils over while the other half, left in the retort, is converted into a basic salicylate, which on acidification of its solution deposits salicylic acid. From the remarkable antiseptic properties which salicylic acid, now for the first time obtained in quantity, has been found to possess, its manufacture by the above process has already achieved a certain importance. It is exhibited by the firm of F. von Heyden (Germany), working under the patent of Dr. Kolbe, as well as by the Joint Stock Chemical Manufacturing Company, formerly E. Schering (Germany), and by other firms.

Naphthaline products.

The later portion of the kreasote oil, which it is not worth while to subject to any treatment for the extraction of carbolic acid, furnishes, on cooling, an abundant crystalline deposit, technically known as "salts," and consisting mainly of naphthaline, readily obtained in a sufficiently pure state by subjecting the deposit to pressure, and the resulting cakes to sublimation. This very

beautiful crystalline body serves as the source of various colouring matters, more particularly of the two known as naphthaline-red and Martius' yellow respectively. These products are shown by various exhibitors of aniline colours, but more particularly by the Berlin Aniline Manufacturing Company (Germany) with which Dr. Martius is connected. For the production of naphthaline red or rosanaphthylamine, sublimed naphthaline is converted successively into nitronaphthaline, naphthylamine and azonaphthyldiamine, by the usual series of processes, and this last is then treated with naphthylamine and acetic acid. Rosanaphthylamine, though furnished by a dissimilar process, is apparently the analogue of rosaniline. Its principal salt is the hydrochloride, which is precipitated by addition of common salt to a previously neutralised solution of the "melt" (or crude product of the reaction) in dilute hydrochloric acid. It occurs as a deep greenish brown crystalline powder, dissolving in alcohol to form a magnificently fluorescent red solution, and imparting to silk a pink colour of quite exceptional brilliancy. Martius' yellow, or dinitronaphthol, is producible from naphthaline in various ways, but most usually nowadays by converting the naphthaline into a naphthaline-sulphonic acid by means of sulphuric acid, and the sodium salt of this acid into a naphthol by its fusion with caustic alkali. The so produced naphthol, gently warmed with a mixture of nitric and sulphuric acid, yield the dinitronaphthol as a deep yellow crystalline solid, imparting to silk a strong but pure yellow colour. Naphthaline serves further as a source of phthalic acid, which is usually made by acting with nitric acid on the liquid product of the combination of chlorine with naphthaline. By regulated heating, the lime salt of this acid is transformed with loss of carbonic acid into a benzoate; and so serves as a source of benzoic acid, heretofore obtained principally from gum-benzoin. Heated by itself, phthalic acid loses water and sublimes in the form of phthalic anhydride which, heated with another coal-tar product, resorcin, furnishes a "melt" of phthalein-resorcin, better known as fluorescin, from the deep green fluorescence of its ammoniacal solution. Treated with bromine, this fluorescin yields the new red colouring matter tetrabromofluorescin or eosine, so called from the brilliant aurora-red colour which it imparts to silk. The resorcin furnishing the fluorescin is obtainable in various ways, most usually by acting on benzol, the chief constituent of coal-tar naphtha, with fuming sulphuric acid so as to form the di-sulphonic acid, and decomposing the salt of this acid by fusion with caustic alkali. Eosine bids fair to become an important rival to safflower and cochineal. In addition to the houses already mentioned a fine collection of naphthaline colours, including eosine, is exhibited by the firm of Durand and Huguenin (Switzerland).

Phthalic acid and eosine.

After the above-mentioned kreasote oils yielding carbolic acid and naphthaline, the next crude product of the distillation of coal-tar constitutes what is known as "anthracene oil." This product, on cooling, forms a sort of thin paste, from which the liquid portion known as "green oil" is separated in the first instance by mere filtration and ultimately by hydraulic pressure. The mixture of this green oil with the kreasote oils, deprived of their carbolic acid and in part usually of their naphthaline, constitutes the kreasote of commerce, used for "pickling" railway sleepers and timber generally. The cake of crude anthracene, left by expression of the green oil, is broken up and treated with coal-tar naphtha or with petroleum spirit and again submitted to hydraulic pressure; and the product of so-called washed anthracene is sometimes submitted to sublimation. Lastly, the sublimed or sufficiently washed anthracene is completely purified by crystallization, at first from naphtha or petroleum spirit, and finally, in some cases, from glacial acetic acid. Anthracene obtained and purified in this way, is the source of the madder-dye products alizarine and purpurine, the artificial production of which, originated by Graebe and Liebermann in 1869, although encountered by many difficulties, has now arrived at such an extent and perfection that the cultivation of the madder plant may already be looked upon as a doomed industry. The methods that have been successively introduced for the production of madder products from anthracene are of various kinds. The plan most generally followed was devised almost simultaneously by Perkin, and by Graebe, Liebermann, and Caro. It consists in first oxidising the hydrocarbon anthracene, $C_{14} H_{10}$, into the oxi-hydrocarbon anthraquinone $C_{14} H_8 O_2$, by means either of nitric acid or of a mixture of sulphuric acid and red chromate of potash. The resulting anthra-

Anthracene products.

Process of alizarine manufacture.

quinone is then heated with sulphuric acid, whereby there is production jointly, though in different proportions according to circumstances, of the anthraquinone mono-sulphonic and di-sulphonic acids. These acids are next converted together into their respective sodium salts, which are separated from one another more or less completely by reason of the superior solubility of the di-sulphonic compound. Lastly, by gentle fusion of the mono-sulphonic salt with caustic alkali there is production of alizarine $C_{14}H_6(OH_2)O_2$, commercially pure; while by similar treatment of the di-sulphonic salt there is production of a differently tinted so-called alizarine, consisting in large measure of two isomeric forms of purpurine $C_{14}H_5(OH)_3O_2$. For the isolation of the alizarine, &c., the fused products are extracted with water, the solutions acidified, usually with dilute sulphuric acid, and the resulting yellowish brown precipitate of alizarine collected, subjected to pressure to remove excess of water, and sold in the form of a thick paste.

Alternative processes.

According to the above method, the anthracene of coal-tar is first oxidised into anthraquinone, which is next transformed into anthraquinone sulphonic acid. A modification of this process, due to Graebe, Liebermann, and Caro, consists in first converting the anthracene into an anthracene sulphonic acid, which is then oxidised into anthraquinone sulphonic acid. This modification, however, has not received much practical development. Another plan, however, that of Perkin, which also dispenses with the separate formation of anthraquinone, is practised with considerable success, the alizarine (purpurine) which it furnishes, though characterised by a yellow tone which unfits it for certain uses, being capable of affording specially bright rose and even violet tints. According to this process, anthracene is first acted on by chlorine, whereby it is converted into di-chloranthracene, which by treatment with sulphuric acid is next transformed into a chloro-sulphonic acid, which last, submitted to oxidising agents or simply heated to 210° C., is transformed into an anthraquinone di-sulphonic acid, yielding a specially characterised alizarine (purpurine) by fusion of its soda-salt with caustic alkali. Artificial alizarine is shown, together with natural madder products, by the firms of Thomas Brothers (France), and of Przibram & Co. (Austria), as well as by many exhibitors of coal-tar colours generally. The development to so large an extent of the manufacture by artificial processes of by far the most important of all natural dye-stuffs, to the exclusion already in very great measure of the natural product, may justly be held to constitute the most notable triumph of industrial organic chemistry that has ever yet been achieved.

William Odling, M.B.

Mr. ISAAC WATTS.

COTTON, LINEN, AND OTHER FABRICS.

REPORT on "COTTON, LINEN, and other FABRICS." By ISAAC WATTS, Esq., late Secretary to the Manchester Cotton Supply Association.

COLONEL HERBERT B. SANDFORD, R.A., Executive Commissioner, International Exhibition, Philadelphia.

SIR, Manchester, November 2nd, 1876.

IN accordance with the request contained in your letter of August 1st, I have the honour to furnish the following report, to be submitted, if desired, to the Lord President of the Council, upon the exhibits in the Centennial Exhibition which were assigned for examination to the Judges constituting Group VIII., of which I was the President. Group VIII.

The Secretary of this group was Mr. Edward Atkinson, of Boston, Mass., the following gentlemen acting as Judges: Judges.

Mr. Hugh Waddell, jun., Savannah, Ga.
Colonel Ed. Richardson, Jackson, Miss.
Mr. A. D. Lockwood, Providence, R.I.
Mr. Charles H. Wolff, Cincinnatti, Ohio.
Colonel Samuel Webber, C.E., Manchester, N.H.
Mr. George O. Baker, Selma, Ala.
Mr. W. W. Hulse, C.E., Manchester.
Don Alvaro de la Gándara, Spain.
Major A. Goldy, Switzerland.
Professor Gustav Herrmann, Germany.
Professor Giuseppe Dassi, Italy.

The cotton, linen, and other fabrics included in Classes 228, 229, 230, 231, 232, 233, 234, 665, and 666 comprised the manufactures of all countries represented at the Exhibition, but, as was to be expected, the largest proportion was supplied by the United States of America. Great Britain, France, Germany, Italy, and other continental nations were restrained from making as extensive and varied a display of their manufactures as they might have done by the excessive protective tariffs which restrict and almost entirely preclude trade with America. The inevitable result was to prevent so complete a comparison as might otherwise have been made, and thus to frustrate one of the most desirable and valuable purposes of an International Exhibition. Classes 228, 229, 230, 231, 232, 233, 234, 665, 666. Excessive tariff a hindrance to display.

Class 228 consisted of woven fabrics of mineral origin, including the various applications made of the Asbestos fibre. Some of these were remarkable for the taste and economy displayed in their production. The wire fabrics for manufacturing purposes comprised several novel improvements, and the fireproof lath composed of wire for ordinary mortar plastering, or Asbestos covering, appears likely to be of considerable utility as an effectual means of contributing to the safety of buildings in case of fire. The various properties and uses of Asbestos as shown in this class were especially interesting, and for steam packing, steam joints, roofing, pipe covering, and other purposes where excessive heat or fire has to be overcome, this remarkable mineral product seems to be of great value. Obtained in quantity from various countries in Europe and the different States of America, it has, notwithstanding its brittle character, been subjected to a successful process of disintegration, and a soft, silky, indestructible fibre is produced, possessing, in a remarkable degree, the properties of toughness, elasticity, and non-conduction of heat. Even wood covered with Asbestos, moistened with water or other liquid, and hardened by exposure to the atmosphere is able to defy the action of fire, whilst the abundance and cheapness of the material appear likely to lead to its extensive practical application. As a covering for pipes used for the transmission of water or steam it can scarcely fail to attract increasing attention, whilst as a material for the production of non-combustible writing paper it may prove to be of advantage where the preservation of private or public documents is of importance. Woven fabrics of mineral origin. Asbestos fibre. Wire fabrics. Fireproof lath. Properties and uses of Asbestos. Whence procured. Multiform uses.

Coarse fabrics of grass, rattan, cocoa-nut and bark.

Class 229.—This class was remarkably rich in the exhibits of coarse fabrics of grass, rattan, cocoa-nut, and bark, and the display was in all respects highly satisfactory. The various novel, economical, and useful articles of rattan deserve special mention, whilst the grasses and barks, in fibres and fabrics, evince considerable progress, and indicate the wonderful expansion in this direction which may be expected. In mattings, Chinese, Japanese, palm-leaf, grass, and rushes, and in the floorcloths of rattan and cocoa-nut fibre, aloe fibre, &c., it was satisfactory to observe the thorough blending of the artistic and the useful which had been secured. There seems to be a vast field yet to be explored as regards the different varieties of these fibres, and their application to practical purposes. Much scope also yet remains for the exercise of invention in the production of the machinery, which an increasing demand for these fibres will render necessary. The more extensive employment of them for floorcloths, mattings, &c. may be required by the special attention given to sanitary considerations, particularly in the heated miasmatic regions of America, and in countries with a similar climate.

Mattings.

Large field of labour yet unworked.

Scope for invention in machinery.

Sanitary employment of matting.

Textile fabrics.

Classes 230, 231, *and* 232.—In these classes the textile manufactures of all countries have been well represented, and although the collections of some are more extensive and diversified than of others, there is sufficient in all cases to show the progress made by the different competitors and their capabilities, as well as to afford valuable opportunities for comparison. The United States have taken full advantage of the occasion for the display of their goods, and have furnished a striking illustration of the rapid progress which they have made in the various branches of the cotton industry, but owing to the hostile tariffs which are still maintained in America, foreign manufacturers have not thought it worth while to coöperate so heartily and generally as could be desired in contributing to the completeness of the Exhibition. They have refrained from incurring the necessary trouble and expense in the conviction that they would not be recompensed by additional trade, and under the apprehension, at the same time, that they might afford keen competitors the means of depriving them of the full fruition of their own improvements. The comparatively meagre display, however, which in consequence has been made of foreign cotton fabrics is nevertheless sufficient to prove to the American manufacturers that their competitors have nothing to fear whenever they can meet on equal terms. France has furnished but a scanty and unimportant collection of her textile manufactures, whether plain, dyed, or printed, and none of them present any special features to attract attention; the absence of Alsace and Lorraine was moreover partly ascribed to the unwillingness of their manufacturers to appear as German exhibitors. The collective exhibits from the Gladbach district, Würtemburg, and Elberfeld, in Germany, though not numerous, were distinguished for their excellent qualities, and some cotton prints were deserving of special notice on account of the beauty of their colours and designs. The contributions from Austria, Italy, Switzerland, the Netherlands, Belgium, Spain, and Portugal comprised some excellent specimens of honest well-made goods. One of the most artistic exhibits consisted of some cotton velvets and velveteens from Hanover. They were especially noticeable for their texture and finish, and for the variety and admirable blending of the colours, altogether presenting the appearance of silk velvets. The textile fabrics contributed by Australia, New Zealand, and the Colonies generally, with one exception, were neither numerous nor important, but Canada has made a remarkable display, and one which excited surprise and admiration. In articles of clothing, and in cotton and woollen fabrics of various kinds, Canada has proved to be in many respects in advance of the United States. The superior quality of the woollen tweeds and cassimeres, the heavy cheviots and check regattas, the heavy twilled domet flannels, the pure Nova Scotia woollen blankets, the plaid flannel shirtings, twilled jeans, calicoes, heavy sheetings, &c. was unquestionable, and they were unsurpassed by any similar goods in the Exhibition. The British judges having undertaken to make the special and additional awards offered by the Canadian Commission to exhibitors from the Dominion had ample opportunities of estimating the progress which has been made, and the degree of perfection which has been attained.

United States exhibit.

Foreign manufactures.

France.

Absence of Alsace and Lorraine.

Collective exhibits.

Germany.

Other foreign contributions.

Colonial exhibits.

Canada in many respects in advance of the United States.

American display of textiles.

The American display of textile manufactures was extensive and diversified, presenting a large collection of the different fabrics produced in the numerous mills of the New England States, New York, New Jersey, and the other

great centres of the Union, and affording a striking proof of their capability for entering into competition with the manufacturers of other countries, if it were not for the isolation which their protective policy imposes, and by means of which they shut themselves out from the general markets of the world. The goods exhibited, though not all of equal quality, were for the most part pure, firm, and well manufactured, and noticeable for the evenness of the yarn; and the excellence of the weaving, the bleaching, dyeing, and finishing of the various grades and styles of cotton cloth manifested a superiority which is attributable, in some degree, to the abundance of excellent water found throughout the Union. The extensive and complete representation thus made of the textile manufactures of the United States shows the rapid progress which the cotton industry has made, and the vast proportions which it has attained, whilst the character and qualities of the goods produced demonstrate that whenever the swaddling bands of protection shall be burst asunder the rest of the world will encounter a more formidable competitor than has hitherto appeared.

Impolicy of isolation.

General excellence.

Rapid progress of cotton industry in the United States.

Whilst, however, the general excellence of the textile manufactures of other countries displayed at the Centennial Exhibition, and especially of America, is fully admitted, those from Great Britain, though for the reasons already assigned not extensive, have nevertheless amply maintained their high reputation. The specimens sent by the English, Scotch, and Irish manufacturers were of such rare excellence as to excite general admiration, and the praises bestowed upon them made it a matter of regret that the number of the exhibits had not been largely increased. Some goods of superior quality were displayed which are still in demand in the American markets; amongst these may be enumerated quilts and toilet covers, alhambras and counterpanes, brocades, damasks, dimities, towellings, plain and fancy muslins, dress fabrics, plain and twill calicoes and prints, bleached goods, cotton-plush velveteens, satteens, spool cotton, crochet and embroidery cotton, yarns for lace, curtains, and fancy dress manufactures, &c. &c. The goods exhibited were generally conspicuous for exquisite workmanship, elegance of design or harmonious combination of colours, and to such a degree was this the case that they repeatedly called forth expressions of pleasure and satisfaction. Whatever regret might be felt that the English display was not more extensive, there was reason for congratulation that the fabrics exhibited were of surpassing excellence. This was readily admitted by those American judges in the group, who being themselves spinners, manufacturers, or merchants, were well qualified to form a just estimate of the goods submitted to their examination. The efforts made by Great Britain and her Colonies in this and other departments to enrich the Exhibition repeatedly elicited expressions of gratification, the educational advantages likely to accrue to America in consequence were fully appreciated, and increasing evidence was afforded that the system of exclusion which prevents the free acquisition of articles so much admired is becoming a burden too heavy to be long endured.

Exhibits from Great Britain and Ireland.

Rare excellence.

Details of exhibits.

American admiration of British and Colonial exhibits, and appreciation of friendly efforts.

Class 233.—The linen fabrics constituting this class were specially distinguished for their fineness and quality. The manufacturers of Ireland may be said to have taken the lead by the great excellence of their fabrics; those of Scotland were but little behind them, whilst Dresden, Würtemburg, Belgium, the Netherlands, Austria, Italy, Sweden, and Norway all made a very creditable display. The American exhibitors in this class were not numerous, nor did they present so great a variety as their foreign competitors. Some of the fabrics in this class were remarkable for the superior taste manifested in the colouring. Some printed lawns, brocades, and embroidered linens displayed much novelty and elegance of design; the damasks of Dresden, and the embroidered linens in the collective exhibit of Würtemburg are deserving of special mention. If superiority be accorded to the manufacturers of Ireland it is in such a degree only as should extinguish envy and excite emulation. All the countries exhibiting in this class are entitled to commendation, and may be congratulated on the progress which they have made, and the promise which they afford of still further excellence.

Linen fabrics.

Lead taken by Ireland.

Great excellence of fabrics.

Scotland next.

Continental display.

American exhibits.

Class 234.—The oilcloths and other painted enamelled tissues comprising this class transcended anything of the kind seen at previous Exhibitions. The preëminence must, without hesitation, be awarded to the American exhibits; the display was unrivalled. The floorcloths were of surpassing excellence; for variety and beauty of design and colouring they were unequalled by the

Oilcloths, &c.

American superiority.

Creditable Scotch display. Raw cottons, ginned and baled. Southern States. Brazil India. Egypt.

goods contributed by all foreign competitors. The Scotch display was highly creditable, and the materials of a superior description, but in other respects it was inferior to the American collection.

Class 665.—The raw cottons, ginned and baled, included in this class were almost entirely American, the product of the Southern States, presented in the usual full-sized commercial bales. Brazil furnished some excellent specimens, in small bales, of the various kinds of cotton grown in that empire; there was also a considerable collection of the different descriptions produced in India, which, however, was not intended for competition but as an illustration of the mode in which cotton is there prepared and sent to market. From Egypt and the minor cotton-growing countries small samples were furnished, which served to show their progress and capabilities. Some remarkable specimens of Sea Island cotton, grown in Fiji and Queensland, as well as in America, were brought under examination, and excited general admiration on account of the fineness and length of the staple. The mode adopted in dealing with the cotton entered for competition ensured perfect impartiality in the decisions arrived at; a given quantity was drawn from the separate bales by expert samplers, and each lot being numbered was examined without the possibility of knowing in what district or by what planter it had been grown. When the names of the successful competitors were ascertained it was discovered that at least two of them were negroes. This afforded much gratification to all the members of the group, and to myself especially on account of my past efforts to promote the cultivation of cotton in the colonies and dependencies of Great Britain, and throughout the world, *by free labour only*, at the time when the manufacturers of every country were almost entirely dependent upon slavery for the raw material which they required. Having also been entrusted, during the American civil war, with the disposal of the first cotton, consisting of four bales, ever grown by free coloured labour in the then slave-holding States of the Union, I could not but rejoice to meet the negro planter by the side of his white competitor in amicable rivalry, and able to establish a claim to eminence in this great branch of American industry.

Sea island cotton. Fiji and Queensland. Method of judging.

Hemp, flax, jute, ramie, &c. Varieties of jute.

Class 666.—*Hemp, flax, jute, ramie, &c.*—Both in their primitive forms and in the stages of preparation for spinning the assortments were very complete, and the cultivated portions showed that considerable progress had been made in their improvements. This was especially observable in the different kinds of jute exhibited, of which there were several new varieties. The entire collection of these fibres was extremely interesting, and the careful examination of them justifies the expectation that they will eventually prove of great value and come into extensive use. Whether considered botanically or commercially they deserve attention, and may be found capable of a variety of important practical applications. The rheea fibre, known also as China grass, and by its Malay name of Ramie, the Boehmeria nivea of the botanists, seems likely to become of increasing importance as a valuable material for manufacturing purposes. Some specimens of rheea in the rod, and in various stages of preparation, also some yarn and woven cloth made from the rheea fibre alone, and other specimens mixed with silk, worsted, alpaca, mohair, or cotton, as well as some damask table-cloth made from rheea, attracted attention, and will, probably, lead to further experiments with a view to the more extensive utilization of this fibre. Specially distinguished for its silky lustre it is superior in strength to both flax and hemp, whilst jute is inferior to it, not only in strength and durability, but also in its capability for bleaching and dyeing. It enters largely into the mixed dress-goods which possess a silk finish. The brilliant, durable, and useful fabrics, known in the States as "Japanese silk," "Canton goods," "Grass cloth," and "Nankin linen," are said to be composed of this material, in combination with other fibres. The cultivation has of late years been introduced into America, the plant is perennial, yielding three or four crops a year, from 400 lbs. to 500 lbs. per acre at each cutting, or from 1,200 to 2,000 lbs. a year of crude fibre, worth, it is said, from 20 to 25 cents per pound to American manufacturers. There scarcely exists a fibre which on account of its own inherent properties is capable of so extended a range of applications; it possesses in a superlative degree the qualities of fineness, strength, and lustre seldom found in the same perfection in any single fibre, while the unique position which it holds between the usual vegetable and animal fibres assimilates it by its hairiness to wool, and by its

Rheea fibre, *i.e.*, China grass or Ramie. Capabilities. Beauty, strength, and durability. Introduction into America. Extended range of applications. Unique position amongst fibres.

gloss and fineness to silk. The whole of the fibres included in this class were regarded by the judges charged with their examination with peculiar interest, and collections of specimens were made for several public museums.

English sympathy with America.

The conspicuous part which England has taken in this Centennial celebration has afforded striking evidence of the deep sympathy which the old country feels in the progress, social, moral, and industrial, of America. It is gratifying to know that this has been fully appreciated, and hailed with enthusiasm. The hearty coöperation of Great Britain, including her colonies and dependencies, in the Centenary commemoration of the Great Republic has produced the liveliest satisfaction in all parts of the United States, and must tend to cement more closely the ties of friendship and brotherhood. The pleasure experienced on this account was never disturbed by the friendly attacks which were often made on the policy of exclusion which still prevails throughout the Union to prevent free and unrestricted trade between the two countries. Against that policy a practical protest has been made by the absence of so many English manufacturers who otherwise would gladly have contributed to the effectiveness of the Exhibition. With fraternal solicitude England continues to urge the abandonment of this policy, in order that complete commercial freedom may be enjoyed. To this state of freedom, whilst offering her hearty congratulations, England invites America to aspire, in the conviction that it will bring with it the healthy stimulus of competition, and supply powerful incentives to exertion and improvement. This Exhibition has shown how well able the American manufacturers are to compete with all rivals in all parts of the world; its lessons are in fullest harmony with the spirit of progress pervading other countries, and if they listen to its teachings the interdependence of all nations will, as a consequence, be more completely recognized, and the artificial barrier which they have erected under a mistaken view, as we think, of their true interests and prosperity, be overthrown. England by taking so prominent a part in this Exhibition has not only expressed to the United States her sympathy and congratulations at this epoch of their history, but has also manifested, even by the absence of many of her manufacturers, her firm adherence to the principles of her commercial policy. These principles have again been earnestly commended to the favourable consideration of our kinsmen in America, in the belief that their acceptance of them would greatly promote the adoption of them by all the other nations of the world.

Hearty coöperation of the Empire with the Great Republic.

Absence of English manufactures a silent protest against protection.

General excellence of American manufactures. Ability to compete with all rivals.

Past progress.—Great as it has been in the cotton industry of the United States, as shown by their textile manufactures at this Exhibition, it has not been confined to them. Judged alone and in relation to former periods the American progress was conspicuous, and proved that a high degree of perfection has been attained. The collections, however, from other countries, though less extensive, indicate a progress no less remarkable, fully justifying a claim at least to equality, if not in some cases to superiority. This was notably the case as regards Great Britain and the Colonies—Canada especially in some of her manufactures was entitled to preëminence—and as far as England has been represented in this branch of industry her well-earned reputation has been abundantly maintained. That she might have made a more extensive display of her textile manufactures is unquestionable, but nevertheless it was one of such rare excellence as to excite general admiration, and amply sufficient to convince American competitors that free access to their markets would endanger the monopoly which they now possess. On all sides development and progress have been strikingly manifested, and if this is more conspicuously so in some cases than in others, all will be inspired with new life and impulses which cannot fail to induce fresh efforts to excel in the peaceful but glorious achievements of industry and commerce.

Past progress.

International comparison.

Competition.—On the subject of American competition there has been much misapprehension and needless alarm, which it is desirable, if possible, to dispel. It is important to ascertain the position which England occupies in relation to the most formidable of her competitors, who belonging to the same race are endowed with equal skill and ingenuity, are as capable of patient continuous effort, and who possess, moreover, a rare combination of facilities and advantages which they well know how to turn to account for the promotion of their own interests. What is the true state of the case? Is there reason for the panic alarm which this dreaded competition has excited? As regards their

Concluding remarks.

own markets the manufacturers of the United States hold the supremacy not on account of the superior excellence or greater cheapness of their goods, but solely through the rigid exclusion of foreign and competing fabrics. Their tariff is arranged expressly to prevent competition, and to ensure to native producers a complete monopoly, so that if English made goods should appear in these markets the purchaser must pay for them from thirty to fifty per cent. more than he otherwise would do. This addition of fifty per cent., more or less, thus made by the tariff to the legitimate cost of the English-made fabric is not to be attributed merely to the greed of the American manufacturer—it is not so much extra profit which he obtains at the expense of the consumers—but it is owing chiefly to his inability to produce the goods as cheaply as his foreign rival, and the remedy is obtained by keeping that rival altogether out of the market. As regards America, therefore, it is not a question of competition at all, but of exclusion and prohibition, and whenever this shall cease and equal terms be secured, England will have no reason to be afraid of the issue. She is not now beaten in the contest, but only kept out of the field by impenetrable barriers. The policy itself is sufficient indication of the views which prevail in America as to the ability of England to compete with her manufacturers. Were it proper to go into the question it might be shown that neither in the raw material, machinery, skill, nor cost of labour have American manufacturers any special advantages, whilst in some respects they are less favourably circumstanced than their English rivals. Nothing but the abandonment of the system of exclusion now so rigidly upheld is wanted to render the trade with America as extensive and important as that which England carries on with any part of the globe.

Should such a change ever come and this prohibitory policy be relinquished—a consummation earnestly desired by increasing numbers in America—the textile manufacturers of the United States may then be encountered in the markets of the world at large, in which at present they scarcely appear at all as rivals to those of England. Such competition, should it ever be experienced, cannot be formidable to those who have long reigned supreme in these markets, and there has been nothing revealed at the Centennial Exhibition to show that England would have any difficulty in maintaining the position which she has already gained. Untrammelled by the fetters which others lack courage to break, eager to make further progress and to discover and appropriate new improvements from every quarter, she demands nothing more than equal terms—a fair field and no favour—and wherever under such conditions competition may be encountered she will not be found wanting. If the moral tone, the sobriety, and intelligence of the operative classes of Great Britain, upon whom so much depends, can be improved, as there is reason to hope from the spread of education, we should then have an additional guarantee of the ability of England to maintain her position in the markets of the world. For excellence and cheapness the textile manufactures of Great Britain were not surpassed by those of any other country represented at the Philadelphia Exhibition.

I have the honour to be,
Sir,
Your faithful and obedient servant,
ISAAC WATTS,
Judge and President of Group VIII.,
Centennial Exhibition.

Mr. W. W. HULSE, C.E.

TEXTILE MACHINERY.

Report on Textile Machinery shown at the International Exhibition, Philadelphia, 1876. By W. W. Hulse, Esq., C.E.

Dear Sir, Manchester, March 6, 1877.

I have not found it practicable to frame a report, based on comparison, of the progress making by different nations in Textile Machinery, as manifested at the Exhibition in Philadelphia in 1876. In no instance was there a complete set of working machines exhibited in the class of "Machines for the manufacture of Cotton Goods" by or for any nation. The most complete set belonged to the United States, but was not worked, and that from France was closed against competition. From Great Britain there were few exhibits of machines for manufacturing cotton. As regards extent of invention and ingenuity, the United States was far ahead of other nations. I do not remember an exhibitor who had not some features of novelty and ingenuity to claim in the machines he exhibited, and as regards consummateness of invention and arrangement of mechanism (due to an older experience) the palm was in my judgment earned for Great Britain. The extraordinary extent of ingenuity and invention existing in the United States, and manifested throughout the Exhibition, I attributed to the natural aptitude of the people, fostered and stimulated by an admirable Patent Law and system, and to the appreciation of inventions by the people generally.

Machines for the manufacture of Cotton Goods, Class 521. United States. France. Great Britain. Superiority of American machinery in inventive ingenuity. Consummateness of invention and arrangement of mechanism carried off by Great Britain. Admirable Patent Laws.

In "Machinery for the manufacture of Jute" there were but two exhibitors, both from Great Britain, viz., Messrs. Samuel Lawson and Co., Hope Foundry, and Messrs. Fairbairn, Kennedy, and Naylor, both of Leeds., and their examples were of the most solid, simple, and best class. It fell to my duty also to judge the various "Floor Cloths" exhibited. In "Oil Cloths," I had no hesitation in assigning the first place to the United States, for variety, designs, richness of colours, and quality of texture of floor cloths, table cloths, carriage cloths, and fancy cloths for upholstery. In "Oil Floor Cloths" of extraordinary size, Scotland furnished the best example, those of Messrs. Michael Nairn and Co., Kirkcaldy, being excellent in quality, flexibility, and durability. In other "Floor Cloths," the "Boulinikon" from England, Boulinikon Floor Cloth Manufacturing Co. (Limited), Manchester, and the "Linoleum" from the United States, American Linoleum Manufacturing Co., New York, were unsurpassed.

Manufacture of Jute, Class 524. Floor and Oil Cloths, Class 234. United States. Scotland. Boulinikon. Linoleum.

The Judges for Group VIII., in which Class 234 was included (Floor Oil Cloths, and other painted and enamelled tissues, and imitations of leather, with a woven base), were:—

Judges for Group, Class 234.

Mr. Isaac Watts, President, Manchester.
Mr. Edward Atkinson, Secretary, Boston, Mass., U.S.
Mr. Hugh Waddell, jun., Savannah, Ga., U.S.
Colonel Edward Richardson, Jackson, Miss., U.S.
Mr. A. D. Lockwood, Providence, R.I., U.S.
Mr. Charles H. Wolff, Cincinnati, Ohio, U.S.
Colonel Samuel Webber, C.E., Manchester, New Hampshire, U.S.
Mr. George O. Baker, Selma, Ala.
Mr. W. W. Hulse, C.E., Manchester.
Don Alvaro de la Gándara, Spain.
Major A. Goldy, Switzerland.
Professor Gustav Herrmann, Germany.
Professor Giuseppe Dassi, Italy.

Classes 521, Machines for the manufacture of Cotton Goods, and 524, Machines for the manufacture of Miscellaneous Fibrous Materials, the subject of this Report, were also considered by a sub-committee of Group VIII.

Classes 521 and 524.

I have, &c.
William W. Hulse.

To the Executive Commissioner,
British Section, International Exhibition,
Philadelphia, 1876.

MR. HENRY MITCHELL.

WOOL AND SILK FABRICS.

Report of **Henry Mitchell**, Esq., of **Bradford**, in the County of **York**, a **Member** of the **Council** of the **Bradford Chamber** of **Commerce**, the English Judge of the various articles exhibited in Group IX. at the Exhibition held in Philadelphia in the year 1876.

GROUP IX.

Judges.—Wool and Silk Fabrics.

Elliot C. Cowdin, President, New York; Henry Mitchell, Vice-President, Great Britain; John L. Hayes, Cambridge, Mass.; Chas. L. Boutillier, Philadelphia; Chas. J. Ellis, Philadelphia; J. D. Lang, Vassalboro', Maine; H. C. Goodspeed, Salt Lake City, Utah; Consul Gustav Gebhard, Secretary, Germany; Dr. Max Weigert, Germany; Mons. Louis Chatel, France; Theodore Bochner, Austria; Carl Arnberg, Sweden; Jno. G. Neeser, Switzerland; Hayami Kenzo, Japan; August Behmer, Egypt; Albert Daninos, Turkey. **Judges.—16.**

Amongst the above named were gentlemen thoroughly conversant with the raw material, as well as woollen manufacturers, merchants, and general dealers, thus the judges were able to arrive at a generally accurate decision on the great variety of articles submitted to their judgment.

The final awards were not left with the judges, whose only duty it was to examine the goods and report separately on each exhibit and recommend awards, where, in their opinion, such were merited. The ultimate decision in all cases was left in the hands of the United States Commissioners.

In nearly every exhibit of foreign goods the prices were attached in American currency as well as in that of the country of manufacture. The United States exhibitors did not mark their goods, but supplied the judges with the prices, which was a necessary element in making the award. As a rule the woollen manufactures of America ranged from 40 to 50 per cent. higher in price than those of the same quality from England and most other European countries. **United States Exhibits, prices, not marked but given to Judges.**

It will, however, be necessary to take into consideration the duties levied on wool, and the different descriptions of goods imported into the United States, before we can form a correct estimate of the position occupied by the manufacturers in that country.

The following are the duties imposed on— **Tariff.**

Carpet wools at 6*d.*	per lb. and under,	1½*d.*	per lb.	
„ exceeding 6*d.*	„	3*d.*	„	
Other wools at 16*d.*	„ and under,	5*d.*	„	and 11
„ exceeding 16*d.*	„	6*d.*	„	10
Woollen goods		2*s.* 1*d.*	„	35
Blankets, costing 1*s.* 8*d.*	„ and under,	10*d.*	„	35
from 1*s.* 8*d.* to 2*s.* 6*d.*	„	1*s.* 3*d.*	„	35
2*s.* 6*d.* to 3*s.* 4*d.*	„	1*s.* 8*d.*	„	35
above 3*s.* 4*d.*	„	2*s.* 1*d.*	„	35

Wool (Class 667).

America.—At the opening of the Exhibition the show of American Wool was very deficient; this defect was pointed out to the Director General. A good exhibit was afterwards made by Ohio, New Hampshire, Oregon, Connecticut, and other wool-growing states, chiefly of the Merino breed, well adapted for the manufacture of Flannels, Blankets, and Medium Cloths. **American Wool.**

No Lustre Wool was exhibited in this department, America being almost entirely dependent on Canada and England for the supply of this class of wool. **No Lustre Wool shown.**

Canada. Excellent Exhibit. Varieties.

CANADA made an excellent exhibit of the two great classes of wool, comprising samples of the Merino, Southdown, Lincoln, Leicester, and Cotswold; also crosses from the—

Leicester and Cotswold. Leicester and Southdown.
Lincoln and Cotswold. Lincoln and Merino.

Lamb and Skin Wools were also shown in considerable variety.

The Southdown and Leicester and the Leicester and Merino crosses are the best, and are largely used in the United States.

Great Britain.

GREAT BRITAIN, at the opening of the Exhibition, had no representation of Wool in the fleece, but a large variety of small specimens were shown from most of our wool-growing counties. After my return home a full and complete assortment of Fleece Wool was sent out by Messrs. James Oddy & Sons, of Bradford, to the Exhibition.

Messrs. James Oddy & Sons, Bradford.

Australia and New Zealand best Exhibit in building.

AUSTRALIA AND NEW ZEALAND made by far the best exhibit of wool in the building. Several hundred specimens of both Combing and Clothing Wool, Merino, Saxon Merino, Ramboullet, and Lambs Wool with a great variety of crosses from the Lincoln, Merino, Leicester, and Cotswold, all of which were excellent in quality and fineness of hair. Some of the exhibitors possess flocks varying from 150 to 200 thousand sheep.

On the whole I am of opinion that there has never been such a fine collection of wool brought together as that shown by the Australian Colonies.

Mohair or Goat's Hair.

Specimens of Mohair or Goat's Hair were also shown in this class.

Cape. Fair display.

THE CAPE had a fair display of both combing and clothing wool, but not equal either in quality or condition to that from Australia.

Russia. Donskoi and Merino Wools.

RUSSIA made a very good show of Donskoi and Merino Wool; some samples of the latter were of superior quality and in excellent condition.

Hungary, Saxony, and Silesia. Very fine Fleeces.

HUNGARY, SAXONY, AND SILESIA displayed a few fleeces of the finest descriptions of Clothing Wools, quite equal to anything in the Exhibition, and well adapted for the manufacture of the finest cloth.

Argentine Republic. Greasy and washed Merino Wool nearest in quality to Australian.

THE ARGENTINE REPUBLIC showed a very large assortment of both greasy and washed Merino Wool, chiefly of the former, some of which was of excellent quality and growth, many of the fleeces being heavy, weighing from 10 to 28 lbs. in the grease. This wool more nearly resembles that of the Australian Colonies than any other shown in the Exhibition.

Spain and Portugal.

SPAIN AND PORTUGAL exhibited a considerable variety of Wool, but very little of special merit.

WOOLLENS (CLASS 235).

America. Large and important Exhibition.

AMERICA.—The exhibition of Woollen Goods was a very large and important one, and far outrivalled that made by the manufacturers of cotton.

Rise and progress of manufacture from 1860 to 1870.

The following figures supplied by Mr. Hayes, the Secretary of the Woollen Manufacturers' Association, will show the rapid rise and progress of this branch of industry in that country:—

——		1860.	1870.
Establishments		1,260	2,891
Sets of cards		3,209	8,866
Horse power, Water		—	59,332
" Steam		—	35,900
Broad Looms		—	14,039
Narrow Looms		—	20,144
Cotton used	lbs.	—	17,571,921
Domestic Wool	"	83,608,468	154,767,095
Foreign "	"	—	17,311,824
Shoddy "	"	—	19,372,064
Hands employed		43,360	80,053
Males above 16 years		—	42,728
Females above 15 years		—	27,682
Youths		—	9,643
Wages paid	dols.	9,610,254	26,877,575
Capital employed	"	30,862,654	98,824,531

As to the details of the amount of wages paid great difficulty was experienced in obtaining accurate information, but the following may be taken as indicating a fair average:— *Average of wages same period.*

1860	- -	4⅓ dollars or 17*s.* per week.
1870	- -	6½ ,, 24*s.* ,,

The working hours are generally 66 per week. There is no Saturday half-holiday. *Working hours.*

Since 1870 wages had declined, but to what extent I have not been able to ascertain with any degree of accuracy. However, the position of the working classes in America is practically very little different from that of those in England, making allowance for the difference in the cost of living. *Decline of wages since 1870.*

In 1850 the total value of all the Woollens produced in the United States was 43,207,545 dollars.

1860	- -	61,894,986 dollars.
1870	- -	155,405,358

Yarns.

In different qualities and colours, comprising specimens of Shetland, Saxonia, Balmoral, and Cashmere for knitting purposes were displayed, some of which closely resembled the celebrated Berlin Wool. *Qualities and Colours.*

The principal goods exhibited by the Americans were 6/4 Fancy Cassimeres of Wool and Silk and Wool, varying from 12*s.* to 17*s.* per yard in different styles and patterns, very similar to those made by the English and Continental manufacturers.

Widths and prices.

		s.	*d.*	*s.*	*d.*		
6/4 Fancy Cassimeres -	from	10	0	to 16	0	per yard.	
6/4 Broad Cloths - -	,,	8	0			upwards	
6/4 Moscows - -	,,	9	0	to 18	0	,,	
Castors, 20 oz. -	,,	8	0	to 16	0	,,	
Doe Skins - -	,,	4	0	to 8	0	,,	
6/4 Worsted Coatings -	,,	8	0	to 15	0	Patterns and designs very similar to English goods.	
6/4 Flannel Suitings -	,,	7	6			upwards.	
6/4 Moscow Beavers -	,,	9	0	to 16	0	,,	
6/4 Light Cassimeres -	,,	5	6			,,	
6/4 Hairlines - -	,,	11	0			,,	
6/4 Cotton Warp Repellants	,,	3	0	to 4	6	,,	12 oz. to the yd.
6/4 All Wool - -	,,	7	0	to 8	6	,,	
6/4 Twilled Cloths -	,,	12	0	to 15	0	,,	about 22 ,,
6/4 Ladies' Waterproof Sackings (all wool)	from	4	3			,,	6½ oz. ,,
6/4 Fur Beavers - -	,,	18	0			,,	30 oz. ,,
6/4 Devon Kerseys -	,,	15	0	to 17	0	,,	26 oz. ,,
6/4 Fancy Overcoatings and Elysians -	,,	14	0	to 18	0	,,	
6/4 Cotton Warp Fur Beaver (shoddy) -	,,	4	6			,,	
6/4 All Wool Fur Beaver	,,	7	6			,,	
6/4 Iceland Roughs (cotton warps) - -	,,	1	10			,,	
6/4 Cotton Warp Repellants	,,	2	9			,,	
6/4 All Wool Overcoatings and Chincillas	,,	9	0	to 10	0	,,	
6/4 Worsted Suitings -	,,	12	0	to 18	0	,,	

BLANKETS (CLASS 237).

Widths and prices.

Width in Inches.	Weight.	Cost per Pair.	Cost in England for similar Goods.
	lbs.	£ s. d.	£ s. d. £ s. d.
66/84	5	0 17 0	0 7 6 to 0 8 0
80/96	9	1 10 0	0 13 6 „ 0 14 0
80/96	10½	2 8 0	1 0 0 „ 1 1 0
80/100	11	2 14 0	1 2 0
90/110	14	4 8 0	1 15 0
85/90	16	2 12 0	1 10 0
Cotton Warp - 56/72	4½	0 7 6	0 4 6 „ 0 4 9
„ „ - 56/72	4¾	0 11 0	0 5 6 „ 0 6 0

Blankets.

Coloured Blankets, 1*s.* 6*d.* per lb.
Brown Greys, 11½*d.* per lb.
Blankets made from Californian Wool, from 24*s.* to 10*l.* per pair, embroidered with the Imperial Arms and with the Arms of the Republic, also Blankets used in travelling, in great variety, were exhibited.

Shawls. Flannels.

Shawls, both woollen and worsted, in handsome patterns and colours, varying in price from 7*s.* to 40*s.*, were shown, also Flannels (Class 236), plain and fancy, white and coloured, of excellent manufacture, the prices of which ranged—

In Cotton and Wool, from 5*d.* to 10*d.* per yard.
All Wool - - „ 1*s.* 6*d.* to 4*s.* „

CANADA made a very creditable display of the following goods:—

Widths and prices.

		s.	d.
6/4 Cheviot Coatings		7	6
3/4 Melton Mixture		3	0
3/4 Tweeds	3*s.* 6*d.* to	4	6
3/4 Knickerbockers		4	3
3/4 Blair Athols		3	0
3/4 Mixed Coatings		3	0
3/4 Fancy Cassimeres		5	0
3/4 Scotch Fancy Twill and Cheviots	3*s.* 0*d.* to	3	9
Halifax Tweeds	2*s.* 9*d.* to	4	0
Home Spuns		2	10
Flannels	1*s.* 3*d.* to	2	0

Knitting Yarns in great variety.

Rapid progress.

Canada is evidently making rapid progress in most branches of industry. Her exhibits of Seal Skins and Furs were unequalled. The display of textile fabrics was highly creditable, whilst the raw material and agricultural produce exhibited, in a very surprising manner, evidence of the great resources of the country.

GREAT BRITAIN AND IRELAND.

Excellent display.

The representatives of this country made an excellent display of Woollen fabrics, which, for cheapness and general utility, were not surpassed by any in the whole of the Exhibition; yet it was not altogether satisfactory, inasmuch as some of the largest and most enterprising firms in the chief centres of this important industry were unrepresented.

America our great rivals.

On comparing our goods with those shown by other countries there can be no doubt that the manufacturers on the Continent are pressing very closely upon us in some qualities of cloth, at the same time we must not forget that our great rival is America. It is, however, highly satisfactory to me to report with confidence, that as regards the goods and their adaptability to the wants of the million there, I saw nothing in the Exhibition that could equal the manufactures of Yorkshire.

Yorkshire still ahead.

At present the Americans show little originality in their designs, while the finish and colour were not so clean and bright as those of English and Continental manufacture.

Yorkshire.

Yorkshire made a very excellent display in the following goods, which compare most favourably with those from any other country.

Widths and prices.

		s.	d.
3/4 27 inch Cheviots		1	3½
6/4 „ „	2s. 8d., 2s. 10d., and	3	0
„ „ all wool	5s. 3d. to	6	9
6/4 „ reversibles		4	9
Waterproofs, Oxford Mixtures		4	9
Naps		2	4
Witneys		2	4
Reversible Diagonals		5	6
„ „ all wool		6	6
Sedan Cloths		6	6
Presidents	2s. 8d. to	4	6
6/4 Calf Hair Coatings			
6/4 Union Cassimeres	1s. 9d. to	2	3
6/4 Mohair, Sealskins, Dogskins	18s. 6d. to	52	0
5/4 Worsted Coatings	7s. 6d., 8s. 9d., 9s., 9s. 3d.,	12	6
3/4 Fancy Cassimeres, Silk and Wool	4s. to	5	3
6/4 Medium Cloths, Deerskins, Light Coatings, Kerseys, Meltons, Beavers, Diagonals, Light Tweeds, Cotton Warp Cloths	All of excellent manufacture and cheap in price.		

No blankets shown.

No Blankets from Yorkshire were exhibited.

West of England.

From the West of England specimens of raw Wool, scoured and dyed, were exhibited; also superfine Woollen Cloth, Beavers, Venetians, Doeskins, Cassimeres, Meltons, Fine Black, Blue, and Scarlet Cloths, Elysians, Kerseys, Hooper's web, Patent Fur, Elysian Beavers, Angola, Woollen Serges, Tweeds, Shawls, Travelling Rugs, Billiard and Piano Cloths, Cotswold Suitings and Fancy Cassimeres, all of first-rate excellence in manufacture, colour, and finish. Although the range of prices was higher than those of any other country (America excepted), yet for quality there were no goods in the Exhibition equal to them on the whole, or with which a fair comparison of cost could be made.

Ireland.

Ireland had a very handsome assortment of Blarney Tweeds, Rugs and Travelling Blankets, mohair and silk robes, also of cotton and wool in variety of design and excellent manufacture. A good display was exhibited of Tweeds made from Australian wool, Tuskar Boating Serge, Worsted Coatings, Tara Frieze, Ulster Coatings, and Homespun goods in Friezes from Messrs. Martin Mahony and Brothers, Cork.

Martin Mahony and Brothers, Cork.

Australia.

Australia exhibited a few woollen Tweeds, of a somewhat primitive character, but substantial and useful goods.

France.

France showed a varied assortment of 6/4 Worsted Coatings, Fancy Cassimeres, Overcoatings, Black and Coloured Cloths, Military Cloths, Flannels, printed Cassimeres, Serges, and Knickerbockers, but no prices were given, neither did the goods equal those of English or German manufacture.

Germany.

Germany.—The German manufacturers considered that as the American market was virtually closed against them, owing to the high duties levied on their goods, nothing would be gained by exhibiting their products.

However, a few goods from thence were exhibited. Amongst which the following may be noticed:—

Widths, prices, and weights.

		s.	d.	oz.
6/4 Worsted Coatings		5	3	16
„ „		5	8	18
„ Heavy „		6	9	25 to 26
„ „ „	6s. 6d. to	8	0	26 to 28
Plain Cloths	7s. 6d. to	8	6	16
Doeskins	6s. to	9	6	
6/4 Overcoatings		8	0	26
„ Fancy Cassimeres	9s. to	10	0	
„ Overcoatings		10	6	28
„ „	11s. to	12	0	32
„ Coloured Military Cloth		8	0	
„ Summer Coatings		5	9	16
„ Winter „		7	9	26

Seal Skins, Dog Skins, Imitation Fur, for ladies' wear, also the celebrated Berlin Wool of the best class, all of which created a very favourable impression on the minds of the judges.

Belgium.

BELGIUM made a very good display of Woollens, at a moderate cost, but inferior in colour and finish to the English fabrics.

Widths and prices.

	s.	d.		s.	d.	
6/4 Light Fancy Cassimeres	3	0	to	5	6	per yard.
„ Heavy „ „	10	0	„	12	0	„
„ Superfine Cloths	6	6	„	10	6	„
„ Worsted Coatings	6	6	„	9	0	„
„ Moscow Beavers	6	0	„	10	0	„
Overcoating Paletots	10	0	„	11	0	„
6/4 Black and Blue Cassimeres	4	3	„	12	6	„

Austria.

AUSTRIA showed a few very choice styles in Woollen fabrics, chiefly from Brünn and Teplitz, also Shawls, Carpets and Rugs, of superior manufacture and handsome patterns.

Russia.
Widths.

RUSSIA made a creditable display of the following goods:—

6/4 Medium and Fine Cloths.
Fancy Cassimeres.
Camel Hair Cloth.
Shawls and Rugs in considerable variety.
Worsted and Woollen Yarns.

Sweden: Widths and prices.

SWEDEN exhibited:—

	s.	d.		s.	d.	
6/4 Fancy Trouserings	6	0	to	12	0	
„ Overcoatings	13	0	„	16	0	
„ Esquimaux Coatings	11	0	„	15	0	
„ Granite Cloth				10	6	
„ Tricots				10	0	
Doeskins				14	6	
6/4 Worsted Coatings	8	3	„	10	6	
„ Ladies' Woollen Cloakings	6	0	„	8	0	
Swedish Blankets, 72/84	18	0	„	20	0	per pr.

These goods compared very favourably, both in price and general excellence of manufacture, with those shown by most other continental countries.

The Netherlands:

THE NETHERLANDS.—The goods from this country do not call for any special notice; the following may, however, be mentioned:—

Widths and prices.

	s.	d.		s.	d.
6/4 Fancy Cassimeres	5	0	to	6	0
Military Beavers	4	3	„	5	0

Overcoatings and Broad Cloths.
Fancy Blankets in considerable variety.
White and Coloured Flannels, from 10*d.* to 1*s.* 4*d.*

Other countries.

The following countries also exhibited a few specimens of woollens, viz., Spain, Portugal, Brazil, Switzerland, Mexico, Norway, Denmark, and the South American Republic.

MACHINERY.

Machinery.

Very little machinery was shown from England, but looms and labour-saving machines were exhibited in great variety by the Americans. Many of them quite original and of great merit.

Nussey and Leachman, Leeds.
Shackleton and Binns, Leeds.

A pressing and finishing machine was shown by Messrs. Nussey and Leachman, of Leeds, which did its work admirably and attracted much attention; also a machine for tying or twisting warps, by Messrs. Shackleton and Binns, of Leeds, which connects 5,000 threads in three hours—one young person being able to attend to three machines.

WORSTED GOODS.

Manufacture of recent origin but rapid progress.

The Worsted manufacture in the United States is of comparatively recent origin, but it has made very rapid progress during the last 10 or 12 years,

the high tariff having greatly stimulated its development, as the following statistics will show :—

Comparison between 1860 and 1870.

—		1860.	1870.
Establishments		3	102
Horse Power		—	4,634
Steam Power		—	3,382
Looms		—	6,128
Spindles		—	200,617
Hands employed—males		1,101	3,864
„ females		1,277	9,056
Capital employed	dollars	3,230,000	10,085,000
Wages paid	„	543,000	4,368,000
Value of material used	„	2,442,000	14,308,000
Value of products	„	3,701,000	22,000,000

The value of the same products in England would not exceed 3,000,000*l.* Since 1870 a slight increase has taken place, but I do not estimate the total produce now (1876) at more than 24,000,000 dollars, including yarns.

The prices of Worsted Stuffs in America rule fully 60 per cent. higher than in this country, but as the duties range from 50 to 120 per cent. (the average being about 70 per cent. on the goods exported from England) there is ample margin to protect the domestic manufacturers, and to enable them to undersell us in their own markets.

Extract from United States Tariff.

The following is an extract from the United States tariff, showing the duties levied on the various descriptions of Worsted Stuffs :—

"Worsted, the hair of the Alpaca, Goat, or other like animals wholly or in part of, of every description (except such as part wool), not otherwise provided for, valued at 40 cents or less per lb. - - - - - } 20 cents per lb. and 35 per cent.

"Valued above 40 cents and not above 60 cents per lb., 30 cents per lb. and 35 per cent.

"Valued above 60 cents and not above 80 cents per lb., 40 cents per lb. and 35 per cent.

"Valued above 80 cents per lb., 50 cents per lb. and 35 per cent.

"On Bunting, 20 cents per square yard, and in addition thereto 35 per cent. ad valorem.

"On Women's and Children's Dress Goods and real and imitation Italian Cloths, composed wholly or in part of Wool, Worsted, the Hair of the Alpaca Goat, or other like animal, valued at not exceeding 20 cents the square yard, 6 cents per square yard, and in addition thereto 35 per cent. ad valorem; valued at above 20 cents the square yard, 8 cents per square yard, and in addition thereto 40 per cent. ad valorem; provided that on all goods weighing 4 ounces and over per square yard, the duty shall be 50 cents per pound, and in addition thereto 35 per cent. ad valorem."

Largely manufactured in the States.

The under-mentioned fabrics are made in large quantities in the States, viz. :—

Coburgs, Cashmeres, Lastings, Figures, Serges, Poplins, Mixtures, Fancy Dress Goods, Plaids, Stripes, Glacés, Moreens, Damasks, and Buntings. Real Alpacas are manufactured in smaller quantities.

The Coburgs, Cashmeres, and Fancy Dress Goods are made mostly from domestic wool, while the Orleans, Alpacas, and Lustre Fabrics are made chiefly from wool grown in both England and Canada, on which there is a duty of about 35 per cent. In this class of goods the Americans are not so well able to compete with the English as in those manufactured from home-grown wool.

Amongst those requiring special mention are the following :—

Summary of goods requiring special notice.

The Alpacas, Cashmeres, and Serges shown by the Farr Alpaca Company were specially good, and the Alpacas, Brilliantines, and Poplins exhibited by the Arlington Mills were excellent in every respect. The Fancy Dress Goods, Mixtures, Cashmeres, and Figures shown by the Manchester and Pacific Mills

were exceedingly well made and got up in good taste, and at moderate prices.

The fabrics, especially the Orleans, Coburgs, and Fancy Dress Goods are generally well made. Some of the former are quite as even and perfect in their manufacture as Bradford goods of the same quality, but the colours not so regular and permanent.

The Americans as yet have not been able to produce any Lustre Wool that will at all compare with our Yorkshire, Lincolnshire, and Nottingham fleeces, nor do they grow any wool of this class equal to that grown in Canada.

Manufacturing concerns.

Nearly all the manufacturing concerns are on a very extensive scale; some employ as many as 5,000 hands and pay 5,000*l.* in weekly wages. On ordinary goods each weaver minds *three* looms and earns from 22*s.* to 28*s.* per week. The speed of their figured looms is 140, and of their plain looms from 150 to 180 revolutions per minute.

These large concerns, however, have other branches of industry; only a portion of these hands are employed in worsted fabrics.

The overlookers and responsible men in every department, from the combing of the wool to the finishing of the goods, are Englishmen, and this applies to almost every branch of wool industry in America.

Hours of labour.

The hours of labour there *are* 66 *per week against* 56½ *in England,* and the wages average about 25 per cent. more than in this country; but the cost of living in America is considerably higher, and I do not think the operatives are in any better position at present than with us.

Machinery imported from England.

The great proportion of the machinery used is exported from England.

Every process of the manufacture, from its earliest stage to the finished goods, is carried on under one management. There are no woolstaplers, combers, spinners, or manufacturers as such, but all combined in one; consequently goods can only be produced in large quantities of one quality and colour.

System of business.

The manufacturers do not deal directly with the merchants or distributors of goods, but they have agents in most of the large cities, to whom they send their productions for sale. The agents charge a commission of 5 per cent., with interest at the rate of 7 per cent. This entails an additional charge on the cost of the goods, and the system is considered to be mischievous, as in many instances they continue to produce goods for which there is not an active demand, while they obtain advances from their agents, and ultimately suffer great pecuniary loss on the sale.

With a moderate tariff we could still compete successfully with the American manufacturers in their own market. With the present uncertainty in regard to the future, it is not likely there will be any large increase in domestic production.

Tariff.

The annexed table shows a list of the exports from Bradford during the last five years, from which it is evident that we are feeling the effects of the competition somewhat severely, but the falling off in the demand for our goods may be partly accounted for by the general depression which has been prevalent in the United States for the past three years.

TABLE showing the EXPORTS of WORSTED GOODS to the UNITED STATES from BRADFORD.

——	1872.	1873.	1874.	1875.	1876.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Stuffs - -	2,992,580 9 0	2,573,802 9 5	2,424,443 6 1	1,982,082 13 10	1,172,666 8 8
Carpets -	391,475 17 6	324,274 17 2	320,524 11 7	184,036 19 4	56,295 1 4
†Wool - -	272,492 10 2	89,909 13 6	46,316 11 5	119,452 6 6	17,744 19 11
Machinery -	47,951 14 11	30,277 11 1	15,129 10 7	24,274 7 8	38,213 8 11
Total -	3,704,770 11 7	3,018,264 11 2	2,806,413 9 8	2,309,846 7 4	*1,288,919 18 10

* The above figures for 1876 are only for eleven months.
† Exclusive of wool certified in Liverpool, of which there has been a considerable quantity.

The show of Worsted fabrics from England was very meagre; and it is much to be regretted that the Bradford manufacturers have allowed such an opportunity to pass without showing the American people how much they are paying for protection, as the prices of English goods were in almost every instance marked both in our own and American currency.

To be regretted Bradford manufacturers did not compete.

In the Main Building only one collection of Bradford goods from E. G. Williams & Co. was exhibited; it contained, however, nearly all the principal articles produced here, such as Orleans, Alpacas, Mohairs, Italian Cloths, Glacés, Figures, Coburgs, Cashmeres, Serges, Silk Warp, and Fancy Dress Goods, all of excellent manufacture, and well arranged, but the space occupied was small, and did not attract that attention which such an important branch of industry demanded.

Messrs. E. G. Williams & Co.

In the Shoe and Leather department there was an excellent display of lastings for shoe manufacture by Messrs. Standfield, Brown, & Co., and Messrs. Kell & Co. (Bradford), with prices affixed in plain figures, showing that we can supply such goods at little more than half the price the Americans are paying for goods of their own manufacture.

Messrs. Standfield, Brown, & Co., Kell & Co., Bradford.

The duties on Lastings, added to the cost of freight and other charges, are nearly 100 per cent., and yet the Americans are not making half the goods required for their own market.

Lastings.

FRANCE made an admirable exhibit of Worsted Dress Goods, especially all wool fabrics, many of which were unequalled in texture and colour. Those shown by Seydoux, Sieber, & Co., of Paris, consisting of French Merinoes, Cashmeres, Silk Warp Cashmeres, Gauzes, Mixtures, De Beges, Plaids, &c., were all of the highest class of merit. They also showed a large assortment of prepared wool rovings and yarn, from which the above-named goods are made.

Seydoux, Sieber, & Co., Paris.

Messrs. Amédée Prouvost & Co., of Roubaix, exhibited a full assortment of wool from Australia, Spain, the borders of the Black Sea, Russia, France, and Belgium, also slivers from the same which are adapted for a great variety of goods.

A. Prouvost & Co., Roubaix.

The Chamber of Commerce of Rheims had a collective display of Merinoes, Cashmeres, Cords, Satins, and Ecosse Cloth dyed by Delamotte. These fabrics were of excellent manufacture, good value, and of beautiful colour.

Chamber of Commerce, Rheims.

The goods dyed by Ernest Houpin, of Rheims, were also of first-rate excellence in every respect.

Ernest Houpin.

Messrs. Robert Guérin & Fils, Rheims, exhibited merino repps, and cords of good value and excellent make and colour. These goods were dyed by Messrs. Poirrier, Mortier, & Muller.

Robert Guérin & Fils.

Alfred Chalamel & Co., Paris, showed Repps and upholstery goods in most chaste colours and excellent in every respect.

There were no goods in the Exhibition which would at all compare with the French in all wool dress fabrics, but in mixed goods of cotton and wool or of cotton, wool, and silk the exhibits from France showed that her manufacturers do not yet compete successfully with the English.

GERMANY exhibited very few worsted stuff goods for dress purposes, but from Elberfeld a very handsome collective display of Italian Cloths and Farmers Satins used for tailors trimmings was shown. The goods being well made, and the colour and finish all that could be desired, yet they could not be sold so cheap as similar goods of English manufacture.

Elberfeld. Good display.

There was also an admirable exhibit of the celebrated Berlin wool yarns by Messrs. Bergmann & Co., Berlin, and others, which were not equalled by any article of the same class in the Exhibition.

Bergmann & Co., Berlin.

RUSSIA made a very creditable show both of Worsted Yarns and Goods, consisting of all Wool Merinoes, Black and Coloured Alpacas, Figured Alpacas, Repps, Serges, Silk Warp Brocades, Baréges, Gauzes, and Fancy Dress Goods in considerable variety, of excellent manufacture, and at moderate prices as compared with the American productions of a similar character. The mixed fabrics of cotton, wool, and silk resembled the English more closely than any in the Exhibition, but the prices were considerably higher.

Russia. Very creditable display.

No other Continental Country exhibited any Worsted stuffs which call for special notice.

Carpets (Class 239).

Exhibit very complete.

The exhibit of carpets by the United States, Great Britain, and the Continent of Europe, were by far the most complete and attractive of any department in this group.

All the leading manufacturers being well represented, the display was most effective in every respect.

Rapid progress in States during last 10 years.

This branch of industry is a very important one in the United States, and has made rapid progress during the last 10 or 15 years, as the following statistics will show :—

—	1850.	1860.	1870.
Hands employed - - -	—	6,681	12,098
Wages paid - - - dollars	—	1,545,000	4,681,000
Material used - - - "	—	4,418,000	13,578,000
Total products - - "	3,401,000	7,837,000	21,761,000

Varieties.

The American manufacturers made a very large display of all the leading varieties, consisting of two and three ply ingrains, costing from one to two dollars per yard; also of Tapestry Velvets, Wiltons, Body Brussels, Tapestry Brussels, and Axminster (at prices ranging from one to three dollars per yard), as well as a great variety of Druggets and Rugs.

Excellent colours. Some of designs original.

These goods were generally well made, the combination of colours in excellent taste, and some of the designs were original. The exhibit on the whole was very creditable for a new country. The prices ruled fully 50 per cent. higher than those of European manufacture.

The under-mentioned is the list of duties imposed upon carpets exported to the United States:

Tariff.

Carpets—Aubusson and Axminster -	50 per cent.
" Woven whole for rooms -	50 per cent.
" Brussels tapestry, printed on the warp or otherwise -	28 cents per sq. yd. and 35 per cent.
" Brussels, wrought by the Jacquard machine - -	44 cents per sq. yd. and 35 per cent.
" Felt - - - - -	40 per cent.
" Hemp or jute - - -	8 cents per sq. yd.
" Saxony, Wilton, and Tournay velvet wrought by the Jacquard machine - -	70 cents per sq. yd. and 35 per cent.
" Treble ingrain, three ply, and worsted chain, Venetian -	17 cents per sq. yd. and 35 per cent.
" Velvet, patent, and tapestry, printed on the warp or otherwise - - -	40 cents per sq. yd. and 35 per cent.
" Yarn, Venetian, and two ply ingrain - - -	12 cents per sq. yd. and 35 per cent.
" of wool, flax, or cotton, or parts of either, or other material not otherwise herein specified	40 per cent.

Great Britain.

Great Britain made a very choice display of Axminster, Wiltons, Tapestry Brussels, and Velvets, also imitation Turkey and Indian Carpets, which for beauty of design and value were equal to any in the Exhibition.

James Templeton & Co., J. J. & S. Templeton, Glasgow.

The Axminsters shown by James Templeton & Co., of Glasgow, were specially admired, also the six-frame Wiltons, exhibited by J. J. and S. Templeton, of that city. The Patent Brocade Curtains shown by the same firm were most elegant and beautiful.

Henderson & Co., Durham.

Messrs. Henderson & Co., of Durham, exhibited some Axminster Carpets, very handsome both in design and colours, and quite as good value as any in the Exhibition.

John Crossley & Sons, Limited, Halifax, showed a considerable assortment of Tapestry, Brussels, Velvet, and Wilton Carpets, in patterns and designs specially adapted for the American market, the prices bearing favourable comparison with any exhibited. John Crossley & Sons, Halifax.

GERMANY made a very good show of Smyrna and Imitation Turkey Carpets, which were greatly admired, especially those made by Gevers & Schmidt, of Schmiedeberg, Silesia. Germany. Gevers & Schmidt, Schmiedeberg.

FRANCE showed some most effective specimens of tapestry carpets, particularly those made by Braquenie Frères, and Duplan, Hamot, & Co., of Paris. The designs and colours were very stiking, and nothing finer was exhibited. The value is said to be from 3,000 to 4,700 dollars each. France. Braquenie Frères, Duplan, Hamot, & Co., Paris.

Some very beautiful Axminsters were exhibited by Arnaud, Gardan, & Co., of Nismes, in French style, colours most delicate, the designs being quite original. Arnaud, Gardan, & Co., Nismes.

Louis Dupont also made an exhibit of Axminster and Wilton carpets, in very handsome patterns and combinations, at moderate prices. Louis Dupont.

From AUSTRIA a few specimens of two and three ply ingrain carpets, also Brussels and Imitation Turkey, all excellent in style and colour and of very good value. Austria.

BELGIUM exhibited some beautiful and striking tapestry carpets, manufactured by Braquenie Frères, Malines, one of which contained a portrait of Rubens. The combination of colours and design were admirable. One carpet was valued at 15,000 francs. Belgium. Braquenie Frères, Malines.

THE NETHERLANDS displayed a few Imitation Turkey Carpets, but the style was not very effective, and they do not call for special notice. The Netherlands.

GENERAL REMARKS.

After a careful examination of all the Raw Materials, Yarns, and Manufactured Goods contained in Group IX., I have no hesitation in coming to the following conclusion, viz. :— General remarks.

1. That no country in the world has been able, so far, to produce Lustre Wool, adapted for the manufacture of Orleans and lustre goods, that will at all compare with our Yorkshire, Lincolnshire, and Nottinghamshire fleeces.
2. That the nearest approach to this class of Wool is that grown in Canada.
3. That while Saxony, Silesia, and some parts of Russia produce wool of the finest qualities adapted for the manufacture of the best woollen cloth, Australia and New Zealand produce a much greater variety suited for combing and clothing purposes, of medium and fine qualities, and are making greater progress in cultivating the growth of these wools than any other country in the world.
4. That in Woollen Manufactures England is still supreme in goods adapted to the wants of the million, and the same remark will apply to the best West of England cloths. In medium goods the competition is very keen with Germany, Belgium, and Sweden, and it is difficult to decide which of those countries can produce the best article at a fixed price, so nearly do they resemble each other. Canada is also producing woollens of excellent manufacture at a very moderate advance on the price of English goods.
5. That in Worsted Stuffs France maintains her pre-eminence in all wool fabrics, such as Merinoes, Cashmeres, Delaines, &c., although some cashmeres are now made in Bradford that will compare favourably with the French, both in make and value, but unfortunately none of these goods were shown.
6. That in mixed fabrics of cotton and wool, cotton, wool, and silk, there were no goods to compare in make and value with our Bradford products, especially Orleans, Alpacas, Mohairs, Italian Cloths, Lastings, and Low Medium priced Fancy Dress Goods, adapted for general consumption, and on which fully 90 per cent. of our machinery is now employed.
7. That the Americans excel in their manufacture of Flannels, Blankets, and Medium Cloths, for which their domestic wool is specially adapted,

but in goods made of foreign wool they do not compete successfully with England, and their woollen goods are not generally so clean and well-finished.

No part of the Exhibition was more striking or impressive than that of the British Colonies, the space occupied being quite as large as that allotted to the mother country.

In conclusion, I wish to express my thanks for the general courtesy shown to me by the authorities in Philadelphia, to Col. Sandford, and Professor Archer, the English Commissioners, and to Mr. A. J. R. Trendell, the Official Delegate to the Judges, for their uniform kindness.

Bradford,
December 1876.

HENRY MITCHELL.

H. PETTIT AND JOS. M. WILSON ENGINEERS AND ARCHITECTS

Length 1402. ft. | Area
Breadth 360. ft. | 504,720 sq. ft.

HYDRAULIC ANNEXE

Length 210 ft. | Area
Breadth 208 ft. | 43,680 sq. ft.

FAIRMOUNT PARK.

IN

SIR SYDNEY H. WATERLOW, BART., M.P.

PAPER, STATIONERY, PRINTING, AND BOOK-MAKING.

Report on Paper, Stationery, Printing, and Book-making, as shown at the International Exhibition, Philadelphia, by Sir Sydney H. Waterlow, Bart., M.P., one of the Aldermen of the City of London.

Highgate, London, W.
30th December 1876.

Sir,

In compliance with the terms of your letter of August 1st, I have the honour to submit the following report for the consideration of the Lord President of the Council upon the several Exhibits in the Centennial Exhibition at Philadelphia, comprised in Group XIII. to which I was more directly attached. All the exhibits referring to Paper, Stationery, Printing, Bookbinding, and Paper making Machinery were classed in this group. The classes referred to are numbered in the Official Catalogue from 258 to 264, also 525, and from 540 to 547, both inclusive. Group XIII. Classes 258 to 264, 525, and 540 to 547.

Seven judges were appointed to consider the several exhibits in this group; viz., five American,—Mr. James M. Willcox, Ph. D., President, Glenn Mills, Pa., 1722, Spruce St., Philadelphia; Mr. H. T. Brian, Secretary, Government Printing Office, Washington; Mr. C. O. Chapin, Springfield, Mass.; Mr. William Faxon, Hartford, Conn.; Mr. Edward Conley, Cincinnati, Ohio; one,—Herr G. W. Seitz, from Switzerland; and one,—myself, from Great Britain. The labour of examining the large number of exhibits rendered it necessary to divide the seven judges into three sub-committees and to apportion the classes with a view of approximately dividing the work. Judges, 7. 5 American. 1 Switzerland. 1 Great Britain.

The exhibits more especially placed under my charge will be found in the catalogue under Class 258, containing fifty-one exhibits from the United States, eight from Great Britain, one from Jamaica, three from Canada, one from the Netherlands, four from Sweden, three from Italy and China, eight from France, three from Germany, and one from Belgium; also in Class 540, in which there were 41 exhibits, thirty-five being supplied by the United States, five by Great Britain, and one by Germany; also Class 547, in which there were only five entries, all from the United States. Classes 541 to 546 contained fifty-one exhibits, thirty-eight of which came from the United States, five from France, three from Canada, and one each from Germany, Sweden, Italy, the Argentine Republic, and Russia; and lastly, Class 525, in which there were seven exhibits, six being supplied by the United States and one by Great Britain. Class 258. 51 exhibits. Class 540. 41 exhibits. Class 547. 5 exhibits. Classes 541 to 546. 51 exhibits. Class 525. 7 exhibits.

Class 258 contained exhibits of stationery for the desk, stationers' articles, pens, pencils, and fancy stationery. Class 258.

Class 259.—Writing paper and envelopes, and papers of first class quality for account books and professional use. Class 259.

Class 260.—Printing papers of all kinds, with wrapping papers of every grade and manufacture. Class 260.

The goods exhibited in these three classes were very numerous, and gave abundant evidence of the advance that has been made in this class of manufacture since the last International Exhibition at Vienna, more especially in the improved texture and durability of the machine made papers for account books and writing paper of the first class; the endless variety and low price of the wrapping paper, and in the greater artistic taste displayed in the preparation of fancy articles for the desk and counting house. Marked advance since Vienna International Exhibition.

Although these exhibits comprised manufactures from nearly all countries represented in the Exhibition, the majority of them were contributed by the United States of America,—Great Britain, France, Germany and other Continental nations being practically restrained from making any extensive display owing to the very high protective and almost prohibitive duties levied by the American Government on the imports of manufactured paper. The prejudicial Majority of exhibits from United States. Other nations, though still exhibiting, being restrained by high prohibitive tariff.

effect of this excessive import duty will be best appreciated by a glance at the following table:—

Table of Imports and Exports, from 1869 to 1876 inclusive.

UNITED STATES.

—	Writing Paper.	Printing Paper.	TOTAL.
	IMPORTS.		
	$	$	$
1869	259,353	96,158	355,511
1870	132,480	49,582	182,062
1871	27,784	218,833	246,617
1872	222,029	350,246	572,275
1873	181,555	546,765	728,320
1874	103,151	288,130	391,281
1875	27,170	20,711	47,881
1876	15,675	3,205	18,880
	EXPORTS.		
1869		3,777	
1876		810,364	

Extensive import of paper from Great Britain before the war.

Before the late war the duty on manufactured paper imported into the United States was very small; there was consequently a very extensive export of paper from Great Britain to America, but the necessities of the Federal Government to meet the cost of the war constituted the first cause for the infliction of the existing prohibitive tariff, and the present import duty is now sought to be maintained for the sake of the protectionist policy to which the nation was then committed and under which it now rests. This policy is naturally vehemently supported by the paper manufacturers of Massachusetts and the other Eastern States, as it effectually secures to them the monopoly of the American home trade, and holds out a very good prospect, as they seem to think, of giving them in future a large and valuable export trade.

Protection policy upheld by Eastern States.

American advantages; water power, atmosphere, cheap coal, and free importation of paper materials.

The Americans possess, no doubt, many natural advantages for paper making; good water power, a clear and pure atmosphere for loft drying, coals at a price almost as cheap as that paid in the best paper making districts of Great Britain, coupled with a free importation of paper materials of all kinds, from the best linen rags to the coarsest and commonest paper stuffs. In the manufacture of the cheaper papers their production is increased by a more extensive use of wood fibre pulp than is customary in this country. They have, however, some disadvantages, one of the most serious of which is the high price of labour. This will be best understood by the following table of the relative rates of wages paid to persons employed in the various processes in the two countries:

Extensive use of wood fibre pulp for cheap paper.

American drawback. High price of labour.

Comparative rates in America and England.

	AMERICA.	ENGLAND.
Finisher and overseer of finishing room.	11*s.* per day.	5*s.* 3*d.* per day.
Engineers	9*s.* „	6*s.* „
Machine tenders	11*s.* „	5*s.* „
Loftmen	9*s.* „	5*s.* 5*d.* „
Firemen	6*s.* „	4*s.* „
Engineers' helpers	7*s.* „	3*s.* „
Machine tenders' do.	4*s.* „	1*s.* 6*d.* „
Millwright	10*s.* „	5*s.* 6*d.* „
Overseer in rag room	7*s.* „	4*s.* „
Helper in finishing room	6*s.* „	6*s.* „
„ loft	6*s.* „	6*s.* „
Women in finishing room about	5*l.* 12*s.* per month	10*s.* per week.
„ rag room	4*l.* 12*s.* „	

Competition in the States.

At the present time the competition in paper making throughout the States is very keen. The production has been stimulated much beyond the home

demand and the ordinary rate of development. To meet this difficulty a combination of paper makers has recently been formed for pushing a trade for American papers in Great Britain and throughout the Continent of Europe. A report given in a New York newspaper of the inauguration of the Confederation, shows that it includes the names of a large nnmber of the best paper manufacturers of Massachusetts and New York. Combination amongst the leading makers to push a foreign trade.

America has for some years past abandoned the practice of making paper by hand, and I was told by one of the leading manufacturers that more than ten years have elapsed since a single sheet of paper was manufactured by hand. All paper machine made.

The surrender of this process has naturally stimulated them to develope their trade in machine-made papers, and also to manufacture account book, bond, and extra superfine writing papers by machine, in order to compete as far as possible with the hand-made papers manufactured in this country for those purposes. Varieties of manufacture.

Among the exhibits I found some very superior specimens of bank-note paper manufactured by machinery. These specimens had quite a leathery feeling, and those who are familiar with the use of well-worn American bank-notes will readily acknowledge how long they wear without tearing. It is, however, remarkable that while so much attention has been bestowed upon the manufacture of machine-made paper, the beauty and finish imparted to them by the use of shaded water-marks from dandy rolls has been entirely neglected, the best paper makers in America using a form of water-mark far inferior to that used in this country. Bank-note paper. Dandy rolls.

From a return which has been recently published, it will be found that there are in the United States at the present time 812 paper-mills running 989 machines and manufacturing 535,000,000 lbs. of paper annually, while in the United Kingdom there are about 274 mills running 420 machines with a product of nearly 350,000,000 lbs. of paper for the same period, thus showing that the machines in this country produce a larger amount of paper per machine than in America. In United States 812 paper mills, making annually 535,000,000 lbs. of paper. In the United Kingdom 274 mills, making 350,000,000 lbs.

It is only just to call attention to the very large and extensive display of gold pens exhibited in Class 258 by American manufacturers. Comparing the display of gold pens with steel pens it would seem to support the statement that gold pens are much more extensively used in the United States than in Great Britain, a very large number of them being manufactured for use in Government offices. Class 258. American gold pens.

This great demand for gold pens has doubtless stimulated American manufacturers to give increased care and attention to their work, resulting in the production of goods competing favourably both in quality and finish with similar European productions.

Class 540.—This class comprised machines of all kinds and sizes for printing newspapers, books, and pamphlets, and for other miscellaneous printed work. It also included every kind of printing press, not the least interesting being one at which JOHN FRANKLIN is said to have worked when a journeyman printer. Class 540. Printing machines.

This exhibition of printing machines and presses was perhaps one of the most remarkable features of the International Exhibition, and it was impossible to examine them without being struck with the extraordinary excellence and completeness which characterised the several exhibits. No description of printing press was unrepresented. There were in all more than forty exhibitors sending in over 100 exhibits, scarcely one of them without its own peculiar excellence and special usefulness. 40 exhibitors and over 100 exhibits.

Of the larger and more powerful machines, I do not hesitate to say that no such collective display has ever before been witnessed, one firm alone showing no less than one dozen different kinds of large cylinder machines in addition to three very powerful and fast newspaper machines. For fast newspaper machines (some of them at work every day) the Philadelphia Exhibition has certainly never been excelled, while the number of job presses worked both by hand and steam power was both encouraging and surprising.

This exhibition of printing machines may be conveniently classed in five divisions: 5 divisions.

(1.) Web machines for printing newspapers very rapidly.
(2.) Large machines for fine illustrated work requiring thoroughly efficient rolling and steady impression.

(3.) Machines for printing newspapers from single sheet with either double or single cylinder.

(4.) Machines for slow newspaper printing and general country work, such as books and pamphlets, &c.

(5.) Job and amateur presses worked by treadle and steam power.

"Walter" press. "Bullock" machine. "Hoe" machines. "Campbell" machines.

With regard to the first division, fast newspaper presses, there were five competitors: firstly, the "Walter" machine, similar to that upon which "The Times" is printed in London; secondly, the "Bullock" machine; thirdly, two "Hoe" machines, one with a folder attached, the other with an accumulator; and fourthly, the "Campbell" machine, erected in a separate building adjoining Machinery Hall. It is no exaggeration to say that no such collection of fast web printing machines was ever before brought together. These machines differ materially in their construction and in the various arrangements for cutting, folding, &c., but they one and all (and certainly the first four) were of such marked excellence as to render them very valuable specimens of machinery, and a most important addition to the power of spreading news all over the world.

Crucial tests.

These machines were most carefully and critically examined, and were thoroughly tested by the judges, the most crucial test being a demand on each manufacturer to run his machine for one hour continuously. This test was satisfactorily carried out with all except the Campbell machine, and the result proved that the "Walter" machine could run with less loss of time in changing the rolls of paper and restoring the broken web than either of the others. This is perhaps to be accounted for by the fact that it is much more strongly constructed than the other machines. It is at the same time only due to the Hoe machines to state that the accumulators and folder worked with wonderful smoothness and rapidity, besides being valuable accessories to the machine.

Superiority of "Walter" press.

Hoe machines, working of accumulators and folder.

Machines for book illustrations.

A very large number of machines were exhibited in the second division, several were at work printing sheets almost entirely covered with first class illustrations both from wood block and electro-types. These machines show a very great advancement since the last International Exhibition. In the French section there were some excellent machines for lithographic colour printing, showing great care and excellence in their construction.

Machines for lithographic colour printing.

Machines for ordinary printing.

Machines for ordinary book and pamphlet work.

The exhibits of the third and fourth divisions comprised machines for ordinary printing, viz., double and single cylinder printing machines for newspapers. Machines for ordinary book and pamphlet work, prospectuses, bills, &c., and all the various kinds of printed books and documents required by railway companies and for commercial purposes. This display was most creditable to the several manufacturers showing as it did unusual care in construction and great improvement in the various labour saving processes introduced into this description of machines during the last ten years.

Job and amateur machines.

Division five consisted of job and amateur machines. The display of these presses in every variety sent by a very large number of manufacturers from all parts of the world, but more especially by manufacturers in the United States, affords the strongest indication of the growing interest taken in the details of the art of printing by a constantly increasing number of persons not practically engaged in that business; a large proportion of these presses having been very successfully designed for affording amateurs the opportunity of indulging in printing as an amusement for leisure hours.

Classes 541 to 546. Type casting machines, apparatus for stereotyping, type setting machines, &c.

Classes 541 to 546 inclusive.—The exhibits in these Classes comprised type casting machines, apparatus for stereotyping, and type setting machines, bookbinding machines, bookfolding machines, paper and card cutting machines and materials for printers use,

A careful examination of the types, type-casting, stereotyping, and type setting machines, conveyed nothing very novel or new in idea. The machines were generally well made, but not, in my opinion, superior to those commonly in use, and which have been exhibited on previous occasions, with the exception perhaps of a machine for casting type and setting it up by one process. This machine displayed great ingenuity in the details of construction, but it is very doubtful whether, having regard to the waste of metal occasioned by recasting for each work, instead of distributing the type, any economy would be effected by the adoption of this invention.

Machine for casting type and setting it up at one process.

Two type-writing machines were exhibited, one by Bain, (John W. Bain, 532, Walnut Street, Philadelphia,) of the same pattern as those now very much in use in this country, and one sent from Russia and never previously exhibited (Michael Alissoff, St. Petersburg); this Russian machine was beautifully constructed, and although somewhat complicated possessed many advantages over the other one, having nearly four times as many characters on the cylinder, and the work when finished being much more clear and elegant in its appearance, in fact much more like ordinary printing. Bain's type writing machine. Alissoff's type writing machine.

Some useful machines for paper folding, and for making card and paper boxes, were exhibited in full operation. The box making machines were especially worthy of notice, and will no doubt materially reduce the price and improve the finish and style of small paper boxes. Machines for paper folding and for making card and paper boxes.

Class 547.—In this class (envelope machinery) four machines only were exhibited, all manufactured and patented in the United States. Three of them were constructed on very much the same principle. They were driven by steam power, producing about 3,000 completed envelopes per hour. One of these machines, exhibited by the Government Stamping Department, delivered the envelopes at the same rate, affixing the revenue stamp at the same time. The fourth machine exhibited great novelty of construction. Taking the paper from the web, each blank was separately cut, gummed both on sides and flaps, and delivered complete ready for use at the surprising rate of 6,000 per hour, or 100 per minute. This machine is, I think, well worth the attention of the manufacturers of this country, working not only more rapidly, but with a much smaller per-centage of waste. Class 547. Envelope machinery. Government Stamping Department.

Class 525 comprised machines for paper making, and the processes connected therewith. The exhibits in this class were, with the exception of one from Great Britain, all sent by the United States. The chilled rolled calenders for paper makers were excellent specimens of very difficult work, but this class of machinery did not in other respects generally indicate any great advance over exhibits seen in previous International Exhibitions. Class 525. Machines for paper making.

I cannot close this report without expressing my great appreciation of the courtesy, kindness, and attention shown not only by the officers and authorities at the Philadelphia Exhibition itself, but by all persons in public positions in America towards myself personally, and, so far as I could learn, all the other judges and officials sent from this country to the Centennial Exhibition. Envoi.

I have the honour to be,
Sir,
Your obedient servant,
SYDNEY H. WATERLOW.

Colonel Herbert B. Sandford,
Executive Commissioner.

HON. JAMES BAIN, LORD PROVOST OF GLASGOW.

HARDWARE USED IN CONSTRUCTION OF BUILDINGS.

Hardware used in Construction.—Locks, Hinges, and Bolts, Furniture Spikes and Nails. By Hon. James Bain, Lord Provost of Glasgow. Group XV., Class 284.

Sir,

Among the various exhibits of native industry at the Philadelphia Exhibition of 1876, household and building hardware and ironmongery held a prominent place. The Judges for Group XV., comprising Classes 280, 281, 282, 283, 284, were— Household and Building Hardware and Ironmongery.

Mr. Charles Staples, Portland, Maine.
Mr. Daniel Steinmetz, President, Philadelphia.
Mr. George L. Reed, Clearfield, Pa.
General John D. Imboden, Richmond, Va.
Hon. James Bain, Lord Provost of Glasgow.
Mr. David M'Hardy, Aberdeen.
Herr Julius Diefenbach, Secretary, Germany.

The articles of like description sent from other countries were small in extent and of limited variety, and so a comparison of the fashion and workmanship on the spot could not well be made. Besides, no exact comparison could have been arrived at between the building and household hardware of Great Britain and that of the United States as the forms and the materials are mostly different, and those in use in America approach more nearly to the kinds adopted in France and Belgium than to those in use in England. It is fair, however, to the manufacturers of the United States to say, that in beauty of design and artistic finish, and particularly in varieties of pattern, they surpassed all European exhibits in the department. For example, while we have only a few patterns in stair rods, and those mostly in brass, the Americans exhibited about thirty different patterns, all of them artistic, many of them exceedingly so, in brass, in various shades of bronze, and particularly in a coating of nickel. I think our manufacturers should specially interest themselves in the action taken by the Americans in the use of this metal. The ironmongery of a building, door knobs, hinges, and such like, which with us is mostly of brass or iron, is by them usually coated with nickel, and the result is a lightness and brightness, and a freedom from oxidation, that our fittings do not possess. Their stove fronts, door plates, and other articles which we usually make of polished iron or steel, are coated with nickel by them, and varnished over with a solution of shellac in methylated spirits, which preserves the articles from oxydation and enables them to be kept clean and bright with little trouble. Beauty of design, artistic finish, and varieties of pattern of American Exhibits. Coating with nickel.

Since the days of Hobbs, who picked the famous Bramah lock, the manufacture of locks in America has often been observed and commented on. It is a very important branch of industry, and the extent of machinery employed and the numbers of firms engaged in the trade are very great. While locks of a kind similar to those made in Great Britain are plentifully manufactured in America, there are specialities as a rule only to be found in that country. Among these are the combination and chronometric locks, and these two sorts, if thought advisable, can be combined. The usual form of a combination lock is one having on it certain letters or numbers arranged in concentric moveable rings. Suppose all the letters of the alphabet are upon these rings, and I resolve to lock the padlock with the letters A L O in a line; I do so, and thereafter I shift and mix the letters. No key will open the lock till the letters are again placed in the same line, and as the combination is known only to myself additional security is obtained by the device. Some of these locks have as many as two thousand combinations. It has been said, "necessity is the mother of invention," and so it has been with the chronometric lock. It is an expensive lock, varying in price from 50*l*. to 200*l*. It is used for banks and safes where money and valuables are kept; and the need Locks. American specialities. Combination locks. 2,000 combinations. Chronometric locks.

Thief-proof safes.

for the invention arose in this way. The thief-proof safes in the United States are, I believe, admittedly superior in quality to those manufactured in Europe; and when burglars effected an entrance into a bank they found they could not drill the safe in the time at their disposal, so they adopted a different mode of robbery. The gang effected an entrance into the bank, and seized and gagged the whole household; they then presented a pistol to the head of the manager and demanded the keys of the safe, and as generally a man will do anything to save his life, they got the keys, plundered the safe, locked it again, and made off, leaving the family gagged. Many burglaries of this kind have occurred in the United States. To prevent such a case happening, the chronometric lock has been invented. It is a mixture of a lock and timepiece, and may also be a combination lock, such as I have described. Suppose the hour of closing the bank is five o'clock in the afternoon, and ten o'clock next morning that for opening it, the manager, when he goes to close the safe, sets the clockwork of the lock to ten o'clock next morning, and then locks the door of the safe; that done, it is impossible for any one to unlock the door till next day; the key is of no use; but next day at ten o'clock, the usual hour of opening the bank, the chronometric arrangement in the lock drops a bolt and permits the key to turn in the lock and the door to be opened. There are many kinds of locks in America mostly made by machinery, and at prices from 2*d.* to 200*l.* each. The quality and accuracy of the workmanship, and the great demand that exists for American locks in foreign countries, are well worthy of consideration by the manufacturers of locks in Great Britain. Among the locks exhibited by other countries, those from Norway deserve honourable mention; they are made by hand, the mechanism is exact, of excellent finish, and the price very moderate.

Inutility through action of thieves.

Remedy in in chronometric lock.

Modus operandi.

Prices.

Concluding remarks.

Looking to the variety and character of the United States exhibits of building and household ironmongery, including locks, it may be said it is more than creditable, in beauty of design, tasteful finish, and adaptability to the end in view, and that the manufacturers of such articles in Great Britain may acquire from them lessons to enable them to compete with the manufacturers of the United States in other countries.

I have, &c.
JAMES BAIN.

To
Colonel H. B. Sandford,
Executive Commissioner,
International Exhibition,
Philadelphia.

MR. DAVID M^{C}HARDY.

EDGE TOOLS,—CUTLERY,—POLISHING AND BURNISHING MATERIALS,-METAL HOLLOW WARE, AND ORNAMENTAL CASTINGS,—HARDWARE,—FIRE PROOF AND OTHER SAFES.

Report on Edge Tools,—Cutlery,—Polishing and Burnishing Materials,—Metal Hollow Ware, and Ornamental Castings, —Hardware,—Fire Proof and other Safes, &c.—Group XV., Philadelphia International Exhibition, 1876.

By David McHardy, Esq.

It will at once be seen that a large number and variety of objects must be embraced in the classes of Group XV., on which this report is made; and it will, therefore, be impossible to do much more than refer to the best collections, but at the same time an attempt will be made to draw attention to any exhibit showing any great improvement or novelty. Opening observations.

Great Exhibitions have had a double influence on the world. First, there has been a vast amount of education imparted by the countries standing in the front rank in civilization to other less favoured realms. Our own country has done much in this respect, so much indeed that many of our producers have cause to regard Exhibitions with a certain amount of distrust, feeling that though others might be benefited by the examination of our machines, little increase of trade would come to the exhibitors. Influence of Exhibitions.

To a certain extent this has been true with regard to Great Britain, but it will not be denied that while in certain things we have educated the world, we ourselves have received in exchange a large amount of education in points wherein we were behind other nations, notably in artistic knowledge, which, since the 1851 Exhibition has, we may say, leapt from contempt into a most powerful position, where it now exercises such an influence in every branch of industry that no manufacturer can afford to disregard it. Now, generally this exchange of advantages has been going on in every country, so that we find as the second result of Exhibitions a general levelling as well as an improving power. The idea of perfection to which the best in each country strain is the same, though the realization of this idea is more or less interfered with by the physical or political conditions of the different states. This statement will serve to explain how it happens that the remarks made about the exhibits of countries which are well known to be in point of civilization very different, should be in many cases nearly the same. Before entering on the description of the various exhibits it may be well also to point out that from a variety of circumstances the display at Philadelphia cannot be looked on as determining with certainty the positions occupied in different industries by the various countries. And first, it must be remembered that the difficulty of transport has, undoubtedly, prevented many European houses of recognised position from joining the Exhibition. Also, the dissatisfaction produced in the minds of many producers, especially in this country, by the heavy duties which the Government of the United States has laid on the importation of foreign goods, has been, without doubt, a reason for the very limited representation of Great Britain, and for the absence of some of the best known names in the different classes of this group. Action of Great Britain and re-action on other countries. Second result of Exhibitions. Difficulty of transport, and United States Tariff hindrances to many exhibitors.

The following table shows the number of the exhibitors in the different classes of Group XV. to which this report refers. As might be expected, the United States are by far the best represented country. Then comes France, between which and the United States there have been for the last 100 years Tabulated statement of exhibitors in classes and nations.

many friendly associations. Canada and Great Britain and Sweden are the best represented of the remaining countries.

	Edge Tools used by Carpenters, Joiners, &c. Miscellaneous Hand Tools.	Cutlery, Knives Scissors, Razors, Skates, and Implements sold by Cutlers.	Emery and Sand Paper, Polishing Powders, Burnishing Tools, &c.	Hollow Ware and Ornamental Castings, &c.	Metallic Products.	Burglar and Fireproof Safes, Safe Lock, &c.
Classes -	280	281	282	283	284	284
The United States - - -	70	34	3	14	9	13
Great Britain - - -	5	7	—	1	4	1
Canada - - - -	23	4	—	—	4	1
France - - - -	7	13	5	12	1	1
Germany - - - -	2	4	1	3	1	—
Austria - - - -	3	1	—	2	1	—
Switzerland - - - -	5	1	—	—	1	—
Belgium - - - -	1	—	—	—	4	1
Netherlands - - - -	1	1	—	—	1	—
Sweden - - - -	6	5	—	—	—	1
Norway - - - - -	—	1	—	2	2	2
Italy - - - - - -	1	1	1	3	2	—
	124	72	10	37	30	20

Total - 293

Class 280.—Edge Tools and Miscellaneous Hand Tools.

Proportion of United States Exhibitors.

It will be seen from the table that more than the half of the exhibitors belong to the United States.

American natural advantages.

The natural advantages which America possesses in the products of her mines place her in a better position to obtain a high quality in the materials out of which the greater part of the exhibits in this class are made, than is to be found in most of the other countries which were represented at Philadelphia.

Fine quality of iron, and skill in manufacture.

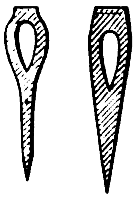
The remarkably fine quality of the iron ore, the care taken in its reduction, and the skill displayed in the manufacture, both of iron and steel, by American firms, result in their productions occupying an enviable position before the world.

Axes.

I. Amongst edge tools a front place must be given to the axe.

There are few countries where the axe has been so much employed or more severely tested than in the United States. The clearing of the forests from so wide an area must have shown to the settlers very correctly not only what was required in the quality of the axe, but what was the best form in which it should be made. General use of axes in United States, and consequent practical judgment.

The American axe has for many years displaced the axes imported from Britain, and these axes are now used exclusively throughout the United States, and in other countries, including Canada, where their excellence has stimulated several Canadian firms to manufacture for themselves axes of a similar character. American axes are now imported into this country, and are found for the purpose of clearing land more efficient than the tools made in the old shape at home. The great proportion of the American axes are manufactured by welding in the steel into the axe after the eye has been partially formed. This mode requires very careful attention and skill, to prevent the steel from being injured in its quality; but the best American axe is made out of a solid piece of cast steel, and the eye is punched out of the solid. These axes are superior, as the steel is not by this plan injured in welding; but there is no difference in the shape of the tool. American axes preferred to those of British manufacture through States and Canada. Introduction into this country. Divergence of form in the American and British axe.



In the original form of the British axe the section would show the eye to be the thickest part of the tool, tapering slightly towards the crown; below the eye the body of the axe is thinned considerably, tapering down to the cutting edge. In the American axe the body is slightly tapered to the crown, and from the eye the body of the axe is kept full and tapered down to the cutting edge.

In felling trees the American axe is more easily worked; its shape enables it to be more easily drawn out after the blow is given, and the body of the axe being much firmer, is not liable to twist in working. American axes made by welding in the steel had their cutting quality severely tested by striking a steel block several times without turning the edge. The demand for this class of axes is enormous, and the number of makers consequently very large, so that we are not surprised to find many exhibitors of the same style of tool with little difference in the external appearance. In most cases the exhibits (which were taken from stock) were polished in a superior manner, and some of them were fitted with handles, so that an opportunity was afforded of putting their quality to the test as explained above. Advantage of form in practice. Severe test as to cutting qualities. Large demand and number of makers.

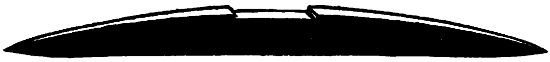
Among the more extensive exhibitors are Messrs. Collins and Company, New York, whose display is one of the largest and most complete in the section of edge tools. It comprises most of the varieties and qualities that are in use, all of excellent workmanship. They exhibit also, a number of picks from 5 to 7 lbs. for mining purposes, with adze eyes, polished and plain. Messrs. Collins and Co., New York.

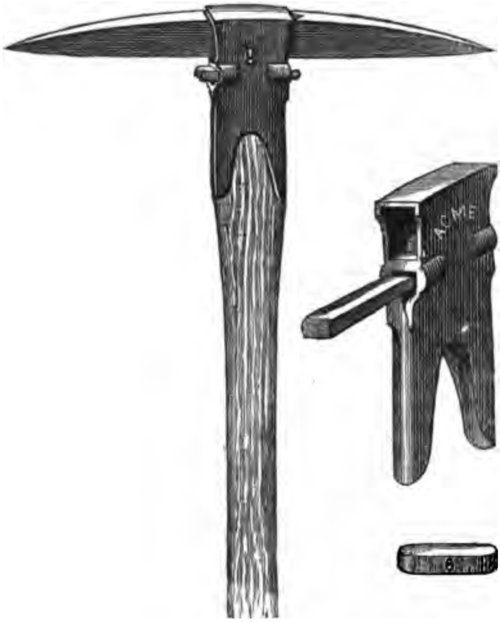
The Douglas Axe Company, Boston, Mass., also show a large assortment of axes, hatchets, and adzes, with patent eyes; also, picks for railway purposes, of the same variety as the exhibit of Messrs. Collins, and good specimens of workmanship. Douglas Axe Co., Boston, Mass.

Yerkes and Plumb, Philadelphia, exhibit a select variety of adzes, cast-steel hammers for machinists and engineers, smiths' hammers, hand and fore hammers, and heavy picks with strong eye for general use. They are all of a high class, the shape having been carefully arrived at, and the manufacture excellent. Messrs. Yerkes and Plumb, Philadelphia.

Pickaxes, &c.

The Hardy Patent Pick Company, Limited, Sheffield, exhibit a large number of *cast-steel picks*, specially made for mining operations; the picks are made of an extra fine quality of cast-steel. The specialty of the pick consists in the mode by which any number of picks can be fitted to one handle. Hardy Patent Pick Company.





Construction.

A malleable iron socket is made to fit the top of the handle, which is parallel, and to which it is strongly rivetted. The upper part of the socket above the handle has an oblong hole 2¼ by 1¼ in. and about 3½ in. long, the picks have no eye in the centre, only a recess 3/8 in. deep cut on the top in the centre, the exact length of the iron socket; the tool is tapered from the centre to the point in the usual form. Below the centre of the socket is a steel wedge, and when the pick is placed in position in the socket, so that the socket is fitted into the recess, the wedge is driven home, and the pick becomes firmly secured.

Dates Patent Steel Company, Toronto.

Dates Patent Steel Company, Toronto, Canada, exhibit a large variety of tools for different industries; viz., cast-steel drawing knives of different varieties, cast-steel adzes for the carpenter and the cooper trade, lath-splitting axes for plasterers, double-ended axes or mattocks for clearing roots, and axes for forest use of the American pattern. The Company make their own steel, and use petroleum in the process.

Messrs. Joseph Warnock and Co., Galt, Ontario.

Joseph Warnock and Company, Galt, Ontario, exhibit cast-steel axes, the axes being forged entirely from cast-steel, and the eye of the of the axes punched out of the solid bar, as already described. In addition to a variety of axes of this description, the company manufacture a large assortment of coopers' tools, adzes, drawing knives, all of excellent workmanship.

Silver medal adjudged to both these firms.

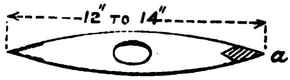
The two exhibitors last mentioned were both considered worthy of a Silver Medal granted by the Canadian Commission to exhibitors from the Dominion.

Mr. Peter Robertson, Ottawa, Ontario.

An assortment of strong lumberman's tools are exhibited by Peter Robertson, Ottawa, Ontario. They consist of long ash handles, about 6 feet, with strong hoops at the lower end, which are further strengthened by iron sockets and sharp points. At some distance from the point an eye with a long hook is firmly fixed through the handle, and this is used for canting the trees. There are a number of these required, and the exhibit shows how carefully they have been made. A number of dogs and rings, and other fixings and shackles for rafts are of the same quality, and well suited for the description of work.

Other exhibits of this firm.

The exhibit also contains a number of cast-steel chisels and puncheons for working granite; short picks with handles, and single axes for the same description of work. The specimen of smith work was good.



The chisels and puncheons are of 7/8 in. octagon cast-steel, and 7 in. long. The picks are made from a good quality of iron, 2¼ in. square at the eye, and tapered to a sharp point; the steel is of the best blister or hoop L quality, and is frequently renewed.

Mr. Thomas Moore, Cooksville, Ontario.

Thomas Moore, Cooksville, Ontario, exhibits a large assortment of tool handles made of clean ash, both round and oval; they are beautifully turned and finished for the several forms required; viz, axes, hammers, of different sizes, steel forks, shovels, &c. The wood is of the lightest description, and in shovels, forks, or instruments for farm or labouring use must be of considerable advantage in lessening the weight of the tool.

Dominion Bronze Medal allotted to these firms.

The Dominion Bronze Medal was awarded by the Canadian Commissioners to P. Robertson and Thomas Moore.

D. R. Barton Tool Company, Rochester, N. Y.

D. R. Barton Tool Company, Rochester, New York, exhibit a fine display of cast-steel hammers, with handles for carpenters, joiners, and for general use. They are made with adze eye sockets for the handles, and well formed claws, clean cut inside. A variety of carpenter and joiner's chisels and other tools for that trade are of excellent workmanship.

Messrs. Geo. Selsor and Co., Philadelphia.

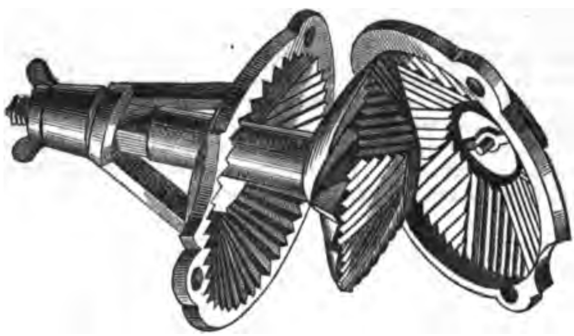
Geo. Selsor and Company, Philadelphia, exhibit a varied assortment of hammers, edge, and railroad tools of good workmanship, and in addition a coffee mill of a new construction; the patentee calls them "Treble anti-friction Coffee Mills." The barrel is formed into 2 flat cones, the upper is cut rough, and the lower cut with a finer pitch to suit any degree of fineness required. The case inclosing the barrel is of iron, in two parts, the cutting inside both being of the same pitch as the barrel which is inclosed. The spindle rests on a steel stud in the centre of the lower case, and prevents any friction in regulating the fineness of the coffee. This is done by a screw on the top of the spindle.

Treble anti-friction coffee mills.

Speciality.

The speciality consists in being able to regulate the degree of fineness when the mill is in motion. All the cutting parts are hardened, and the patentee states that it grinds "as fine as the best French mills and with much greater rapidity. This was tried for different degrees of fineness, and the results were very satisfactory in reference to *the time* employed and *the quality* of the grinding. A suitable mill for a family, with polished poplar box 7¾ in. square, and Britannia hopper, costs in Philadelphia $1·25.

Satisfactory results.



Although only a few exhibitors have been referred to above it will be understood that the number in the class was very large, and that it was with the greatest difficulty that any difference in the quality of the articles displayed could be discovered.

Saws.

If the axe occupies an important position in usefulness, undoubtedly the saw cannot be considered as a less important tool in the workshops of a civilized country. The hand-saw has for ages been constructed on two types. First; the broad flat saw with a handle at the end as used in Britain, and— Second; a thin steel band stretched from two points, such as is used by Frenchmen and Chinese.

Two types of hand-saw.

In America both kinds are used, each kind being employed in the class of work to which it is naturally best suited. In the ordinary workshops the circular and the band saw are now used extensively, and cause immense saving in time and labour by the manner in which curved work is so quickly executed.

Both kinds used in America.

The most extensive exhibit of saws is by Messrs. Henry Disston and Sons, Philadelphia, consisting of every variety, from the large circular saws for machinery to the smallest band saw of $\frac{1}{8}$ in. in breadth. Some of the largest circular saws have separate steel teeth inserted in the circumference, and so fitted that the friction in the operation does not loosen their hold or destroy their efficiency.

Messrs. Henry Disston and Sons, Philadelphia.

The hand saws were carefully examined, not only in hardness of the steel, but in the quality of the temper. Several hand saws were tried by striking the back of the saw upon a bloom of cast-steel without marking it in the least degree, and the same saws were bent until the point touched the wooden handle, and when let free sprang back to their former shape, perfectly straight.

Severe testing.

Disston and Sons have made improvements in the form of the handles, and in the mode of fixing them to the saw; there is also an improvement in the shape of the blade, by which it is made lighter and more convenient by giving it a greater taper to the point. The smaller saws with brass and iron backs were of excellent workmanship. In addition to the different varieties of saws they exhibit an assortment of steel squares and rules, correctly graduated, and marked by figures beautifully finished; also an assortment of levels for workmen, with finished stocks. This firm is one of the largest in America; they employ 1,200 hands, and manufacture their articles from Sheffield steel, using up all their waste cuttings.

Improvements.

Extent of manufacture.

It is creditable to the Dominion of Canada to have such a firm as that of Messrs. R. H. Smith and Company, St. Catherine, Ontario, representing the growing manufactures of the Province. Their case contained (besides the large circular saws for machinery) a great display of all descriptions of cast-steel saws, frame saws, hand and tenon saws, and a variety of the smaller sizes of carpenters' tools. The steel used by this firm is stated to be Jessop's. The quality of the tools is excellent, and the workmanship superior. This firm obtained the Gold Medal of the Canadian Commission for the great extent and high quality of their exhibit.

Messrs. R. H. Smith and Co., St. Catherine, Ontario.

Special Gold Medal, Canadian Commission.

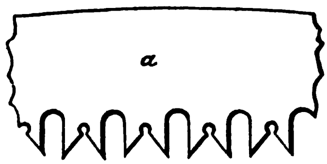
The American Saw Company, Trenton, New Jersey, exhibit an extensive assortment of machine and hand saws, the latter showed great excellence in the manufacture by the elasticity and the workmanship of the tools.

American Saw Co., Trenton, N. J.

Mr. Eben Moody, Boynton, New York, exhibits a good selection of saws of cross-cut and other variety of considerable extent; they are made out of the best cast-steel, and well finished; also ice and dray saws. The speciality of this exhibit was a cross-cut saw, which is named "the Patent Lightning Saw," from its performances. Its novelty is in the shape of the teeth, which are different from those of an ordinary cross-cut saw.

Mr. Eben Moody, Boynton, N. Y.

Patent Lightning Saw.



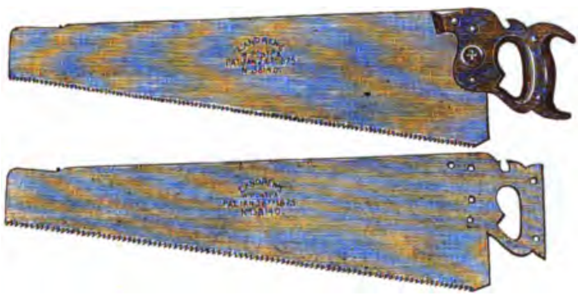
By the form of the teeth the saw can cut both by the forward and backward motion. An experiment was made in the presence of two officials of the effect of this form of teeth, when two men cut through a 16 in. log in 17 seconds.

This firm also shows a new form of pruning saws with cutting teeth on *both edges;* they are made from 14 to 22 inches long, and are said to be much more convenient than the common form.

Pruning saws.

Mr. Andrews, of Williamsport, Pa., is the maker of a flat hand saw, which has the handle considerably strengthened by the simple means of allowing the steel of the saw to pass right to the end as a flitch between the wooden pieces of the handle, to which it is firmly rivetted.

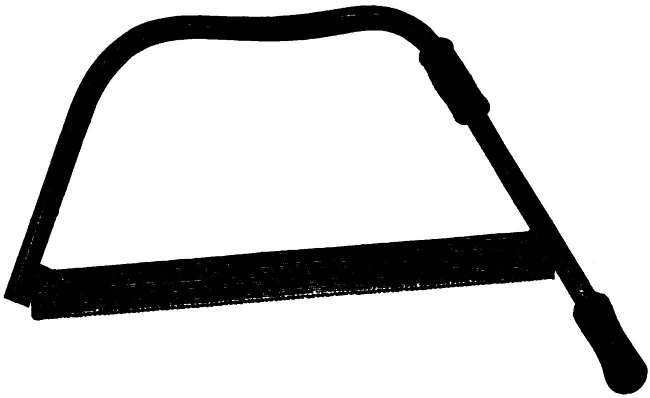
Mr. E. Andrews. Williamsport, Pa.



Flat hand-saw.

New method of giving strength.

The same maker has also a simple and clever saw frame, by which the saw is kept always properly strained without the means of a brace.



Saw strained ready for use.

The exhibitors in this class of goods are chiefly from the United States; Great Britain has not a single representative, although for years Sheffield supplied not only our own country but nearly all the world. It will be seen from what has been already described that this monopoly remains with us no longer, and it is to be hoped that the knowledge of this fact will rouse up the manufacturers in England to try and achieve as far as may be possible in present circumstances, a position of equal distinction to that held by their predecessors.

Absence of British exhibits in this class.

Augurs, &c.

In remarking upon tools generally employed in the manufacture of wood, it will be necessary to notice the class used in the heavier branches of the building trade and those that are required in the workshops of joiners, carpenters, cabinet-makers, turners, carvers, and by amateurs and others. In this section the augur on account of its many uses in the arts may be considered the most important exhibit. The grand display of examples and the number of exhibitors bore testimony to this fact. The exhibits as we have noticed in other classes are for the most part manufactured in the United States, the number from other countries being very limited.

Extensive use.

Majority of exhibits from United States.

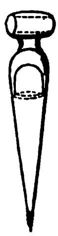
Improvements in qualities of augurs and varieties used.

Great improvements in the qualities of augurs have been made during recent years, as shown in the many varieties now in general use. The old shell augur is very rarely employed, and the screwed form of the tool has taken its place. The augurs exhibited at Philadelphia were remarkable for the accuracy of the twist, the various forms of the cutters, the quality of the steel, and the fine finish of the twist and polish, all showing a degree of perfection not previously reached. An opportunity was afforded of testing the quality of two varieties, in boring a piece of pine and a piece of walnut by an augur, with Jenning's patent bit, and one with a gouge lip bit, both of 14·16 diameter. The result was nearly the same in the cross boring, but in the end wood, specially of the pine, it was agreed after a fair trial that the gouge bit made the cleanest hole.

Single Twist Bits.

A class of augurs was shown different in the form of the screw, and named "Single Twist Bits," but they are more expensive and not so generally used as others.

The number of turns of screw varied; in the augurs which were tested the screw did not exceed 6 turns. Smaller sizes have from 6 to 8 turns, while a variety called car bits, used principally by coach builders, have the twist extended to 16 turns. These car bits are more expensive than the common gouge lip bit of the same diameter; a very fine exhibit of them was shown in the Machinery Hall at the back of Messrs. Disstons' display.

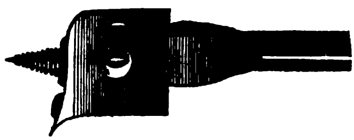


Tap Borers.

There was a limited show of augurs named "Tap Borers," different in shape from any of the other forms, and used in making wooden pipes. They are made hollow, of steel, and fixed to an iron socket-head for the handle, and have a long taper with screw point. The width at the shoulder where the iron socket is attached, measures from 6 to 8 quarters of an inch.

Expansive Boring Bit.

For boring large sized holes, an instrument named the "Expansive Boring Bit" is shown.



It consists of a steel spindle with screwed point like the augur, and has a plate about 2 inches long formed behind the screw, and about one inch broad. A cutter is formed on one of the edges, and there is a steel knife with oblong hole to admit a steel screw to fix it to the flat part of the spindle at any distance required to form the exact size of the hole. The knife has a sloped point set at any angle, as the plane iron.

Jenning's Spur Augur Bits.

American augurs, such as "Jenning's Spur Augur Bits," from the manufactory, Deep River, Conn., are in use in Great Britain generally, indeed they are found in the northern parts of this country; they are somewhat more expensive than home made augurs, but are preferred in many instances on account of the excellence in the workmanship and quality of the tool. Altogether the Philadelphia Exhibition has fully established the reputation of American augurs.

Reputation of American augurs established.

In the section of tools, comprising cast steel chisels, gouges, turning and carving tools, there is a good exhibition. The larger sizes for heavy work are furnished with sockets for the handle, while the smaller descriptions are made with a shoulder and tang. In the best tools, the shoulder is made out of the

Messrs. Buck Bros., Riverlin Works, Milbury, Mass.

solid. A very large assortment of this section is shown by Messrs. Buck Brothers, Riverlin Works, Milbury, Mass. Tang tools of considerable variety are exhibited, they are well made, and the finish of the turning tools and the plane irons is of a superior character.

R. D. Burton Tool Co., Rochester, N. Y.

D. R. Burton, Tool Company, Rochester, N.Y., exhibit a good selection of mechanics' tools of different kinds, of good workmanship, the smaller size have been turned out with a very neat appearance.

Messrs. Ward and Payne, Sheffield.

A case of scientific tools for brass, iron, and wood turnings are exhibited by Messrs. Ward and Payne, Steel Manufacturers, Sheffield; they show also, all the varieties of tools used by carpenters, millwrights, masons, and bricklayers, all of a high class. Their display further embraces a superior assortment of cast steel, carving and turning tools for iron, brass, ivory, and wood gravers for die sinking; the firm also manufacture sheep shears of excellent quality.

Star Tool Co., Middletown, Conn.

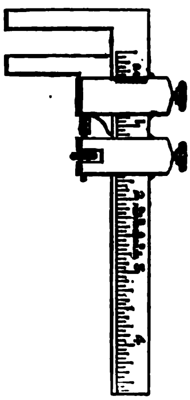
The Star Tool Company, Middletown, Conn., in addition to the usual variety of carpenters' tools, exhibit a select assortment of squares with rose wood stocks, and steel blades accurately graduated to different divisions of an inch; also, bevil stocks made in the same style, flexible steel rules to 36 inches, and a variety of steel calipers; the whole of this exhibit is very attractive, and the prices are moderately charged; a 12 inch square being only $1·0.

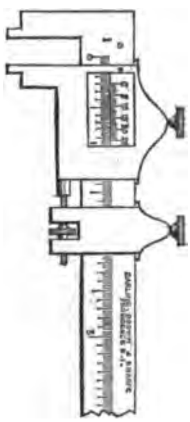
Messrs. J. B. Addis and Sons, Sheffield.

An extensive collection of tools from Messrs. J. B. Addis and Sons, Edge Tool Manufacturers, Sheffield, comprised sets of tools for carving stone and wood in all the varieties, they are of the finest cast steel and made in a thoroughly first class style. Turning tools of the same quality for ivory, iron, brass, and wood are also shown, as well as a good collection of the usual carpenters' tools.

Messrs. Darling, Brown, and Sharpe, Providence, R. I.

A most interesting exhibit was that of Darling, Brown, and Sharpe, Providence, R.I. It consisted of a varied selection of instruments of precision, such as steel squares, rules, calipers. The extreme perfection with which the scales were graduated was charming, and their vernier caliper reads to $\frac{1}{1000}$ of an inch. Such an instrument must be highly valued by the intelligent workman.





Planes, &c.

Improvement of workmen's tools due to American inventive genius.

A great part of the marked advance in the improvement of workmen's tools which has been made during recent years, is justly due to the inventive genius of American citizens, and in the section of planes exhibited in the Centennial, this is fully confirmed by an important change in the structure of the tool.

The planes manufactured in Great Britain and in other countries 50 years ago were formed of best beech-wood; the plane irons were of steel and iron welded together; the jointer plane about 21 inches long was a bulky tool, the jack and hand planes were of the same materials. Very little change has been made upon the plane in Great Britain, unless in the superior workmanship and the higher quality of the plane iron. American planes have now found their way into Great Britain, and it will be seen whether the old type is to be preferred, or whether a fair trial is to be granted to the manufactures of the New World.

Peculiarity of American plane.

The American plane is constructed with a skeleton iron body, having a curved wooden handle; the plane iron is of the finest cast steel, the cover is fitted with an ingenious trigger at the top, which, with a screw below the iron admits of the plane iron being removed for sharpening and setting without the aid of the hammer, and with the greatest ease. The extensive varieties of plane iron in use are fitted for every requirement; a very ingenious arrangement is applied to the tools for planing the insides of circles or other curved works, such as stair rails, &c. The sole of the plane is formed of a plate of tempered steel about the thickness of a hand saw, according to the length required, and this plate is adapted to the curve, and is securely fixed at each end; with this tool the work is not only better done but in less time than formerly. In some exhibits the face of the plane is made of beech or of other hard wood, secured by screws to the stock, and the tool becomes a hybrid, all the other parts remaining the same as in the iron plane.

A few examples of the old type of beech plane were shown, remarkable for the superior quality of the workmanship, and were mounted with polished iron starts. The finish of the iron planes was different according to requirement, some were ground and japanned, others polished and some nickel plated, the higher finish being on the smaller sizes. It was stated by one firm that their output had amounted to 80,000.

Metallic Plane Co., Auburn, N.Y.
Middletown Tool Co., Middletown, Conn.
Bailey, Leonard, and Co., Hartford, Conn.
Sandusky Tool Co., Sandusky, Ohio.

There were 12 exhibitors to a greater or less extent of first class workmanship, amongst these the following were included—

The Metallic Plane Company, Auburn, N.Y.
The Middletown Tool Coy., Middletown, Conn.
Bailey, Leonard, & Co., Hartford, Conn.
The Sandusky Tool Coy., Sandusky, Ohio.

Some of the above exhibited wooden bench and hand screws, squares, levels, &c. In several exhibits of carpenters' tools there were a variety of braces and bits, very good specimens of tool making. There were a few examples of a different construction having an expansive chuck for the bit. The steel jaws were jointed to a screwed end which fitted into a screwed "sleeve" or socket. The jaw would admit different sizes of bits in the squares, and when placed, the sleeve was screwed on to the holder, and the bit remained quite secure.

Miller's Falls Co., Mass.
Wm. A. Ives and Co., New Haven, Conn.

The exhibits of the Miller's Falls Company, Mass., and Wm. A. Ives and Coy., New Haven, Conn., contained beautiful examples of the expansive brace, the prices were stated at from $5 to $8.

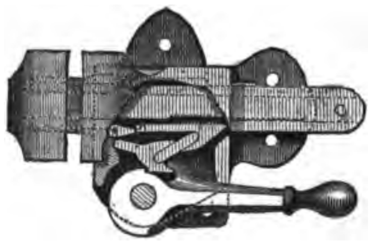
The several exhibits in the section formed an attraction to the numerous artizans who visited the Centennial from the United States and other countries.

Vices.

It may be proper before closing the section of hand tools to select a few used in manufacture of iron, such as the vice. The usual construction of the common vice is well understood; the moveable side is jointed to the standard from 15 to 18 inches below the level of the jaw. The consequence is that when opened a few inches the jaws are not on the same plane, and besides this inconvenience the constant injury to the screw and box through carelessness is expensive. Several examples of vice constructed on new principles were exhibited. **Construction of common vice.**

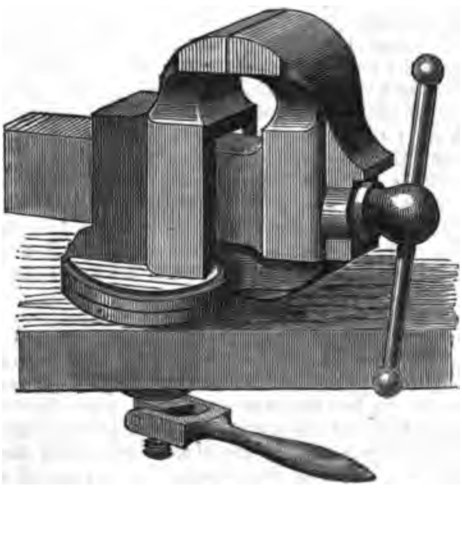
Stephens Patent Vice Company, 41, Dry Street, N.Y., show an extensive selection of parallel vices with width of jaw from 2 in. up to 6½ in. The tool is cast in two separate pieces with steel facings; the front jaw is attached to a parallel bar, planed and correctly fitted to a recess in the main body of the tool, and may be moved forward and backward with ease. On the right edge of the bar a steel rack is inserted cut with ratchet teeth, which are acted on by a handle in connexion with an arrangement of a cam and toggle. **Stephens Patent Vice Co., New York.**

The parallel bar is pulled out to the extent of 10 in. (in the larger sizes) at once, and closed by the hand upon the article to be held, the handle is then pulled tight, and whatever is in the vice is held many times more firmly than is possible with any other vice.



Upon the lower side there is a swivel arrangement which admits of the vice being turned to any angle required. This vice has been well tried, and seems to bear out all that the patentee claims.

Simpson's Adjustable Parallel and Swivel Vice is worked in the same manner as the common screw vice; at the same time the jaws can be instantly opened or closed the full length by one movement of the hand without the use of the screw. **Simpson's Adjustable Parallel and Swivel Vice.**



This vice is well proportioned with steel faced jaws, the screw and the ingenious mechanism are concealed in the interior, and are therefore free from injury by dirt or filings, and as the screw is only used to give the grip they wear exceedingly well.

Files.

Difficulty of comparison.

It is not easy to institute a comparison in the quality of this class of tools; the cutting, which is the only element that can be seen, is not sufficient evidence to fix a true value of the worth of the tool. Sheffield held for many years the front place in the manufacture of files; this did not altogether depend upon the excellence of the cutting, but mainly on the high quality of the cast steel, and on the skill shown in the process of tempering.

There were at Philadelphia 16 exhibits, and of this number there were from manufacturers of the

United States	11
Sweden	5
Great Britain	2
Switzerland	3
France	1
Belgium	2
	24

Two classes of files.

The files were in two distinct classes, viz., machine and hand made.

McCaffrey and Brother, Alexander Krumbhaar, Philadelphia.

Only two of the latter class were shown, by McCaffrey and Brother, and Alexander Krumbhaar, both of Philadelphia. Their exhibits contained several varieties, the cutting was executed with accuracy, and showed considerable skill.

An exhibit near the east end of the machinery hall contained excellent examples of massive files for engineering purposes from 18 to 20 inches long, the workmanship considering the breadth of the flat hand files was exceedingly good, the exhibit was highly creditable.

Western File Co., Beaver Falls, Pa. Nicholson File Co., Providence, R. I.

The Western File Company, Beaver Falls, Pa., and the Nicholson File Company, Providence, Rhode Island, were placed beside each other; the exhibits contained extensive assortments of machine made files of every description; the cutting was well executed in the larger and smaller sizes, the smooth files were beautifully made. The round files of the Western File Company were executed in a superior style.

Hawksworth, Ellison, and Co., Sheffield.

The exhibit of Hawksworth, Wilson, Ellison, and Coy., Sheffield, was very extensive; one of the divisions contained files which were of first rate quality, maintaining the reputation of the firm in Sheffield manufactures.

Limet-Lapareille and Co., Paris.

Limet-Lapareille and Co., Paris, showed two cases of various sizes. They were principally intended for machinists, and were very well adapted for their purpose.

A. De Lambert, Liege.

A very fine exhibit from A. De Lambert, Liege, of some extent, containing a great variety of fine cast steel files of small size for jewellers and watchmakers. Some of the examples did not exceed 2½ in.; when examined through a glass, there was evidence of a skilful hand, and of an educated workman.

Louis François Grobet, Vallorbes, Ct. Vaud.

Files somewhat of the same type were exhibited by Louis François Grobet, Vallorbes, Ct. Vaud; they formed a very creditable display.

Marc Servet Fils, Geneva. Vautier and Sons, Carouge, near Geneva. Jules Leresche-Golay and Co., Vaulion, Ct. Vaud.

I. Marc Servet Fils, Geneva, Vautier and Sons, Carouge near Geneva, and Jules Leresche-Golay and Co., Vaulion, Ct. Vaud, had each an exhibit of the same class of tools; that by Vautier et Fils, Geneva, was of superior excellence. Indeed the cutting of the finer description of the smaller size from Switzerland, and also France and Belgium, showed a delicacy of touch not often seen, and the inspection of their tools produced real pleasure.

Screw Cutting.

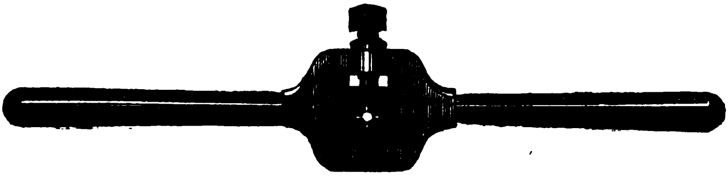
Extent of use of screwing machines.

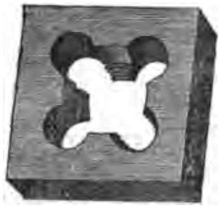
The number of screwing machines now in use, the increase of bolt and nut manufacturers exclusively engaged in the trade, render the use of the ordinary screw plate or die stocks less necessary than it was formerly. In the Exhibition there are only a few exhibits where screwing tools are represented.

Morse Twist Drill and Machine Co.,

An excellent exhibit is shown by the Morse Twist Drill and Machine Coy., New Bedford, Mass. We had here a selection of tools of a high character.

The taps and dies are made from specially imported steel, and are supplied to either of the American Standards or to the Whitworth as required. New Bedford, Mass.





The screw plates are made of a slight character, and the manner in which the die is fixed, admits of it being quickly changed. The exhibitors also manufacture a tool for screwing pipes up to 3 in. diameter, the die in this case is solid, and is fitted into a box with two handles. In addition the exhibit contains twist drills, chucks, and wrenches of superior quality.

J. M. Carpenter, Pawtucket, R. I.

J. M. Carpenter, Pawtucket, R.I., also shews a good selection of stocks with taps and dies. The stocks are constructed on an excellent principle for fixing and changing the dies. The taps and dies are made of special steel to any gauge in sets of three taps to one pair of dies. The stocks are well proportioned.

Agriculture and Labourers Tools.

There are several exhibits connected with agriculture and other kinds of labour which were brought under the consideration of Group XV.

Great improvements in agricultural implements in the United States.

Looking at the exhibits shown in this class at Philadelphia, we are surprised that the great improvements which have been made in the United States in agricultural tools had not been introduced many years ago. The spade was made formerly by having two layers of iron, and a thinner plate of hoop L or of shear steel placed between them by the usual process of welding. The spade was made solid, then cut to the required size, and the scales at the top formed for the handle. **Spades**

Old hay fork.

The old hay fork was made altogether of iron, or occasionally the prongs were pointed with steel. With its iron ferrule and strong ash handle, it was a very cumbrous tool. The manure fork had usually three prongs, sometimes flat, about an inch broad, and were occasionally improved by forming the prongs in the shape of the letter V. If the hay fork was cumbrous the manure fork was doubly so. No accurate judgment can be formed of the many advantages which have been conferred on the labourer by the introduction of the American steel spade, shovel, manure and hay forks, arising from the surface of the metal remaining clean, and the edges or points sharp, while, as it was stated in the exhibition, the difference of weight betwixt the old style and the new steel spade was from 3 to 4 lbs. in favour of steel. **Manure fork.** **Difference of weight between old and new implements.**

A. S. Whitting Manufacturing Co., Ottawa, Ont.

The exhibition of A. S. Whitting Manufacturing Company, Ottawa, Ontario, contains a varied collection of steel hay and manure forks, hoes, and garden tools, of excellent quality and workmanship, and extremely light.

As is well known this quality of goods has for years been imported into Great Britain, being preferred to the older form on account of lightness, and for the freedom with which they can be worked for a much longer time than the heavy forks of former years.

American Shovel Co., Birmingham, Conn.

The American Shovel Company, Birmingham, Conn., exhibit several specimens of steel shovels and scoops; the shovels are of sufficient thickness, and well fastened to properly shaped handles. The shovel is polished, is comparatively light, and of good workmanship. The scoops are well made, and very suitable for the intended purpose.

Middleboro' Shovel Co., Boston, Mass.

The Middleboro' Shovel Company, Boston, Mass., also show a variety of steel shovels and spades made up in the usual manner, with good ash handles; the implements are polished and well suited for work.

B. Rowland and Co., Philadelphia.

B. Rowland and Company, Philadelphia, exhibit an extensive assortment of shovels, spades, and scoops, draining and ditching tools; the manufacture of the implements comprised in this exhibit was marked by careful attention to the best construction of the different tools, and to the lightness of the implement consistent with the necessary strength and fitness for the purpose. The exhibit was very commendable for design and workmanship.

CLASS 281.

Cutlery.

Report on cutlery intended to give merely a general idea.

In this class several of the exhibits contained only one section of the class, while others presented several varieties. In this report the remarks must be limited to those exhibits which best represent the present state of the art in the different nationalities, the purpose being to present a mere general sketch of the grand display exhibited at Philadelphia, and convey an impartial idea of the progress of this particular branch of industry.

Sheffield still prominent, but great emulation elsewhere.

Cutlery has been the most important product of the Sheffield district for centuries, and in our day Sheffield still maintains a prominent position in the department of steel manufacture. Still, the number and excellence of several of the exhibits at Philadelphia shows clearly that there exists an active emulation amongst the manufacturers of cutlery in several of the countries in Europe, but especially in America, where during recent years great improvements have been made in the manufacture, both in the taste and in the quality of the goods, which is very remarkable. The quality of fine cutlery depends mainly on the character of the steel, upon the workman's skill, and on the taste shewn in the finish of the handle, though the last may be considered as secondary to the others. The mode of joining the handle to the blade is also an important point. It may be assumed that for the finest branches of cutlery the best quality of cast steel of Sheffield manufacture is generally adopted. This has been stated by some of the exhibitors of fine class goods, in answer to inquiries regarding the character of the steel used in the manufacture, and is a fact of vast importance not only to Sheffield but to this country.

United States.

John Russell Cutlery Co., Green River Works, N.Y.

The most extensive exhibit of this class was the property of John Russell Cutlery Company, Green River Works, N.Y., and comprised every variety of table cutlery, mounted with handles of pearl, silver, plated handles, ivory, horn, and fancy woods. The carving forks had an improved guard of a double form; the guard on the upper side was made in the usual manner, but the lower half of the guard was formed with double points, resembling a short fork, slightly turned up, and forming a rest for the fork when not in use, and admitting of being forced back when laid aside. A grander display than this exhibit, especially of the finer sections, has rarely been witnessed. The varieties of style, the uniform excellence of the manufacture, as shown by the specimens, were deserving of the highest praise.

Miller Bros. Cutlery Co., West Meriden, Conn.

Miller Brothers Cutlery Company, West Meriden, Conn., exhibited an extensive assortment of pocket cutlery in all the different varieties and qualities. An interesting part of this exhibit consisted in showing specimens of their goods in the consecutive stages of the manufacture, namely, the forged blade, the progress of finishing, tempering, grinding, and polishing, the preparation of the handle, and final finish. The examples contained in this exhibit were of tasteful designs and excellent workmanship.

R. Heinisch's Sons, Newark, New Jersey, exhibited a varied selection of tailors' and other descriptions of shears and scissors. The speciality of this exhibit consisted in the manufacture of the tailor's shears, which had a peculiarly formed handle, made by Mr. Heinisch's Sons out of cast malleable iron, to which in the process the cast steel face is attached. The manufacture was skilfully executed; it was difficult to see (when the shears were polished) where the union of the two metals had taken place. It was stated that many of this description were exported to Great Britain. The whole of this exhibit indicated careful workmanship, and was very creditable. R. Heinisch's Sons, Newark, N. J.

A well selected variety of razors was exhibited by Friedman and Lauterjing, New York. These were described as "concaved razors manufactured out of India steel." The "India steel" may be assumed to mean that a slight alloy of silver has been added to the cast steel in the process of manufacture. Most razors have a degree of concavity more or less, this exhibit, however, showed upon examination to have the concave carried almost up to the back of the razor, and in this manner the edge appears extremely fine. The workmanship of the blades and of the ivory mountings was of excellent quality. This firm also exhibit a variety of razor strops, made of strong Russian leather; the strop was fitted on to a slight wire frame, about ¾ inch apart and 8 inches long, and the frame was connected to the handle by an adjusting screw by which the strop could be tightened as required; the strops were very neatly made. Friedman and Lauterjing, New York.

The Meriden Cutlery Company, Meriden, Conn., exhibit a choice selection of table cutlery in all its varieties. They claim a speciality in the material of which the handles are formed, it bears a close resemblance to ivory, and takes on a fine polish; it was stated to be a third cheaper than the ivory handle. The best qualities of the exhibit were of superior workmanship. Meriden Cutlery Co., Meriden, Conn.

Great Britain.

George Wostenholm and Son, Sheffield, exhibit a well arranged assortment of razors, pocket knives, scissors, and general cutlery; the examples were tastefully designed, and executed in a superior style. It was the unanimous decision of the judges that the exhibit of George Wostenholm and Son, in point of tasteful design, quality, and style of finish, was not surpassed by any exhibit in the same class at the Centennial Exhibition. Geo. Wostenholm and Son, Sheffield.

A large display of cutlery by Brookes and Crookes, Sheffield, comprised a varied selection of table and pocket knives, scissors, and toilet furnishings, also, hunting knives, dirks, &c. This firm manufacture their own steel. The exhibit showed considerable taste in the unexceptionable quality of the goods. Brookes and Crookes, Sheffield.

The exhibit of Thomas Kingsbury, London, contained a varied assortment of razors, knives, scissors, dressing case instruments, and several specimens of processes of manufacture. The variety of the specimens in different classes were of good design and of excellent quality; the specimens in progress were in the usual form. Thomas Kingsbury, London.

William Wilkinson and Sons, Sheffield, exhibited a different class of cutlery from any of the other Sheffield firms, viz., a selection of pruning shears and farriers' knives. The value of this class of tools consists in the quality of the steel, and in the skill of the workman in their construction, a high finish is not required. This exhibit evinced great care, and the tools were admirably adapted for the purpose intended. William Wilkinson and Sons, Sheffield.

France.

A very large case divided into several compartments contained the exhibits of individuals from Haute-Marne, viz., Renaut Guillemin, Charles Girard, Courcelles Sommelet, Felix Thévenot, J. Charbonne-Thuillier, Wichard Couvreux, also Vitry Frères, and Thinet, from Paris. The separate exhibits thus combined almost uniformly to a greater or less degree contained the same description and quality of examples, viz., hunting and pocket knives, kitchen and mincing knives, daggers, razors, folding and common scissors, and a variety of corkscrews and pruning shears. In this very extensive exhibit there did not appear to be any speciality (with one exception to be noted) to require Collective display from Haute-Marne. Renaut Guillemin, Charles Girard, Courcelles Sommelet, Felix Thévenot, Charbonne-Thuillier, Wichard Couvreux, Vitry Freres Thinet, Paris.

any particular remark. A uniform creditable type of workmanship was well maintained by every exhibitor, and where a better style of finish was required, the work (with few exceptions) was executed with skill. It is easy to see that this combined form of an exhibit may be very economical, but it is equally clear that it has its disadvantages, in the difficulty with which an examination of the articles can be made.

Courcelles Sommelet.

The exception above noted has reference to the exhibit of Courcelles Sommelet, which contained a selection of shears and scissors, kitchen knives, &c., the product of the labour of juvenile offenders the inmates of a reformatory institution, and in the circumstance not without merit. It was understood that the whole of the work was done within the walls of the institution.

V. Pèrard, Paris.

A new form of sheep shears was exhibited by V. Pèrard, Paris. They are constructed on much the same principle as the clipping shears now generally used for horses. In inexperienced hands, their employment would greatly diminish the risk of cutting the skin, and the new form is on that account a great improvement on the ordinary shears for clipping wool.

Austria.

Wenzel Schneider, Prague.

The only exhibit in this class was by Wenzel Schneider, Prague, consisting of a selection of pocket cutlery of excellent quality and of beautiful finish.

Sweden.

F. W. Söderén, Eskilstuna.

F. W. Söderén, Eskilstuna, exhibited a selection of shears and scissors of great merit; the examples shown were of superior quality and meritorious.

Sanóvikens Iron and Steel Co., Gefle.

The exhibit of the Sanóvikens Iron and Steel Company, Gefle, contained a number of razors, knives, and scissors. The whole of the examples were said to be manufactured out of Bessemer steel made by the company. From the workmanship and finish shown on the goods the speciality of the steel would appear to be of a superior kind. It opens up a new (though probably not the most suitable) use for this cheap quality of steel. There was a fine exhibit of razors from C. V. Heljestrand, Eskilstuna, Sweden. The blades were of the finest steel, the handles were mostly of ivory, tastefully engraved. The examples shown were executed in a most superior manner.

C. V. Heljestrand, Eskilstuna.

C. A. Morstrom, Eskilstuna.

C. Alfred Morstrom, Eskilstuna, Sweden, exhibited a selection of hunting knives of best quality of steel, mounted with tastefully carved handles, with silver hoops and ornaments, altogether a fine display of superior workmanship.

Germany.

H. Böker and Co., Solingen.

H. Böker and Co., Solingen, exhibited a very fine display of pocket knives scissors, &c. The examples were doubtless made up for exhibition. The pocket knives and scissors were from the finest steel, and were remarkable for the high class of the workmanship. There was also supplied, at request, a selection of the ordinary manufacture, of good quality and at moderate prices. Altogether this exhibit was considered to be of a very superior kind, and showed the amount of careful attention that had been bestowed upon it.

Russia.

John Kaliakin and Sons, Novgorod.

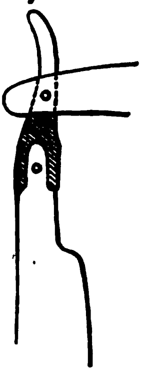
A very extensive selection of table and pocket cutlery, pruning knives, and shears, was exhibited by John Kaliakin and Sons, Pavlovo, Government of Nijni Novgorod. The table cutlery comprised a variety of the usual requirements included in that class, the taste shown in the variety of the handles was excellent. The pocket knives were beautiful in style, and indicated skilful workmanship. The pruning knives and shears were of good quality and carefully made, altogether this selection was very commendable.

Demetrius Kondratoff, Vatcha. Alexis Zavialoff, Vorsma.

The exhibits from Demetrius Kondratoff, Vatcha, Government of Vladimir, and Alexis Zavialoff, Vorsma, Government of Nijni Novgorod, comprised the same examples of table and pocket cutlery; the specimens were of good quality, and the taste shown in the workmanship very creditable. The pruning knives and shears from Novgorod showed skilful workmanship, which in both exhibits was very superior.

Switzerland.

C. F. Schneider, Geneva, exhibited an assortment of knives both with single and multifarious blades; both descriptions showed very great taste in the arrangement and in the fine quality of workmanship for which the Swiss for long years have been justly distinguished. The beautiful arrangement of the many bladed knife was very attractive. C. F. Schneider, Geneva.



Jacques Le Coultre, Sentier, Ct. Vaud, exhibited a collection of razors of different patterns. The specialty of the exhibit consisted in having cases containing a number of razors with one handle, by which a different razor could be used each day; the examples were made of the finest steel, and beautifully ground and polished. The blades were formed with a short tang which fitted into a steel socket of the same form as the end of an ordinary razor. Jacques Le Coultre.

After a general survey of the cutlery exhibition, we are forced to give to America the first place for table cutlery. America.

For pocket and fine cutlery the pre-eminence of Sheffield was maintained by Westenholm, and Brookes and Crookes. France did scarcely justice to herself in the exhibits sent to Philadelphia. Sheffield. France.

The display of Germany in pocket cutlery was no doubt equal to any from the United States, showing great beauty and high excellence of finish. Germany.

The Russian exhibits from Novgorod showed an advance which we were scarcely prepared to see; and Sweden also deserves to be noticed, her products being somewhat of the same quality as those of Russia. Russia. Sweden.

Skates.

Florence Sewing Machine Company, Florence, Mass., showed an assortment of ice skates; the speciality consisted in the mode by which the skate was attached to the foot A strap passes round the ball of the foot and from heel over instep, and the skate is secured to the boot by a thumb screw at the back of the heel. It was understood that a patent had been obtained for this mode of fixing. Florence Sewing Machine Co.

Starr Manufacturing Company, Halifax, N.S., exhibited with their general collection a beautiful stand of the "Acme Patent Club Skate." The skates are shown in great variety of elegant style and of superior finish. The exhibit obtained an award of merit. A different variety of skate was exhibited by the Plimpton Roller and Ice Skate Company. The exhibits were of the ordinary type. There was no specialty pointed out, though the style and workmanship were of very good quality. Starr Manufacturing Co., Halifax. Plimpton Roller and Ice Skate Co.

CLASS 282.

Polishing and Burnishing Materials.

There is little to be said on this class; although the importance of the materials included under it is beyond dispute. To take emery, the part which it is now playing in cutting wheels, and in wheels for surfacing in machinery, is producing many changes in the modes of production; but here we have only to deal with it as a material for polishing. In the class there were two main divisions, viz., burnishers and materials for polishing.

George Leykauf, Nuremberg, exhibited a fine collection of burnishing tools, for use in gilding. These burnishers were made of chalcedony and jasper. These stones, which are found in abundance in Eastern Europe, had their points formed in every variety of shape, so that they might be applied to every part of an ornamental carving, They were very highly polished, and fixed on wooden handles. This was a beautiful exhibit. George Leykauf, Nuremberg.

James Taylor. Providence, R.I. Processes.

James Taylor, Providence, R.I., made a display similar to that just described. These burnishers were adapted for use on carved wood and picture frames, or such like articles of furniture.

Processes.

As is well known the burnishers used for metals are very different from those used for gilding, being composed of fine steel blades with a perfectly smooth edge, the form being governed by the manner in which the burnisher is to be employed. The preparation of the surfaces to be burnished is effected either by the file or by the process of grinding. The ordinary grindstone in some cases may be sufficient in the first instance, but the emery stone is found more expeditious. It is used with water or dry, and is driven at a high speed. To perfect the surface, emery wheels of different grades of fineness are used in their turn. Crocus buffs are next employed, and ultimately putty powder, which is found sufficiently fine to produce a finished surface.

Emery.

The most important of the grinding materials is emery, a mineral of the hardest quality, and universally used in the manufacturing departments of art in grinding and polishing plate glass, lenses, precious stones, granite, and in engine and machine shops. Emery is found in the east of Europe in lumps of considerable size, and sufficient in some cases to form wheels for grinding from 15 to 18 in. diameter, and 2½ thick. The emery stone is often carefully fixed upon an iron spindle, and in this form is extensively used either dry or with water. The smaller pieces are broken down into fragments, and are ground to any required grade in the rolling mill. Sometimes the separation of the different grades is effected by an elaborate process of washing, but in some of the recently erected manufactories in this country, the rolling mill with its variety of sifters has been found more economical in point of time and labour. It is stated that the finest grade of flour emery has been found to be the dust falling from the grinding and sifting processes, which is carefully removed from prepared receptacles formed so as to prevent the chance of any foreign matter being mixed up with it.

Degrees of fineness.

The coarser varieties are numbered by consecutive figures thus, 0, 0½, 1, 1½, 2, 2½, 3; in some cases the qualities are marked by the number of meshes contained within a square inch; this mode is much more likely to be satisfactory than consecutive numbers.

Emery cloth and paper.

This material is also manufactured into emery cloth and paper, by first coating the paper with prepared glue, and sifting the emery evenly on the surface; the cloth is generally of coarse calico, and is treated in the same manner as the paper. Flour emery cloth requires a finer cloth, the process of sifting is the same. When skilfully prepared the emery cloth is preferable to the paper; it endures greater fatigue, is not so liable to tear, and can be used for a longer time; emery is also used for scythe sharpeners by forming a piece of wood into the shape of a flat file with handle, and about 2 inches broad, 12 inches long, coating it with glue, and dipping the wood once or twice in a heap of emery. Emery is also applied to buffing wheels by mixing it with bees wax, melted fat, well worked together.

Crocus.

Crocus is applied in the same way. Crocus is the finely divided red oxide of iron, and is carefully prepared and reduced to a fine powder, and free from grit; the cloth is covered with this powder in much the same form as in the process of covering cloth with flour emery.

Freeman K. Sibley, Waltham, Mass.

The examples of these various articles shown were subjected to a severe test without any appearance of weakness, and the emery never showed any parting from the cloth in the slightest degree. In the exhibit of Freeman K. Sibley, of Waltham, Mass., especially, the surfaces were beautifully regular, and the whole worthy of commendation.

CLASS 283.

Metal Hollow Ware and Ornamental Castings.

This class comprises a number of objects which from their beauty attracted a large number of admiring spectators.

Bronzes.

There is hardly a civilized country where the bronzes of antiquities of Greece and Rome, nay even of China and Japan, are not admired and imitated. To France must be given the highest place as the mistress of artistic bronze in modern times: but we are reminded by this exhibition that

a large group of artistic metal productions have sprung up in various countries, though all to a greater or less degree in sympathy with the character of the French bronzes. Amongst these we notice the zinc and iron castings of Germany and the United States.

The ornamental use of zinc is of very modern date. Indeed it owes its origin to the desire which the general spread of refinement has produced, of having about us in our homes articles in which pure artistic feeling is present.

To the rich this was always within reach, but to the poorer classes the possession of a good bronze, was a thing not to be thought of. The comparative cheapness of zinc figures, more especially when cast by the hundred from a perfect metal mould, has brought the possession of beautiful objects within the reach of persons with slender incomes, and a large trade has thereby been created. The principal necessity for perfection lies in the preparation of the moulds, which, whether of sand or of metal, must be without fault, and equal in finish to a piece of sculpture. **Zinc castings.**

The same remarks apply to the iron castings which have found homes in Germany and the United States, where they are produced in great variety and perfection. The sharpness of many of these castings is wonderful, and convinces one of the need, first of a perfect mould, and secondly of a very fluid metal. **Iron castings.**

In the Exhibition by far the largest and most important display was that of J. L. Mott, Iron Works, New York. **J. L. Mott, New York.**

The extreme elegance of the iron figures was sufficient index of the artistic feeling of the modeller, while the delicacy with which the various bronzes were applied to the surface showed that the American workmen were in no respect inferior to those of Europe. A large fountain in the centre circle of the main building was throughout of the highest character, and extracted praise from every one who inspected it. Another exhibit of zinc castings was shown by Conrad Felsing, Berlin, containing a collection of bust statuettes. The castings were remarkably sharp and clean, and tastefully imitated in bronze colour; this exhibit possessed great merit. **Conrad Felsing, Berlin.**

Alois Winkler, Vienna, exhibited a series of zinc figures and letters, in different styles, executed in a very skilful manner, and of beautiful designs. **Alois Winkler, Vienna.**

Graf Stolberg, Ilsenburg, Germany, exhibited several iron castings of great merit. Two castings of engraved shields were particularly noticeable; they were about 20 inches diameter, and cast in sand. They were extremely light, the pattern had been richly engraved, and the casts were both smooth and sharp; nothing had been done to improve them by filing; one of the castings had not had the sand brushed off. The exhibit was greatly commended. **Graf Stolberg, Ilsenburg.**

A novelty in casting which we had not previously seen, consisted of an exhibition of sash weights, some were broken in pieces to show the quality of the metal; the judges were informed by the exhibitor, J. H. Armbruster, Philadelphia, that he employed labourers with carts to collect during the morning every article of worn out tin plate or sheet iron in whatever shape used for domestic purposes that had been thrown out upon the street. The weight of the rubbish gathered in this manner was surprising, as was also the product from the furnace. At present it is made into sash weights of a much higher specific gravity than ordinary iron. The metal also shows a degree of hardness equal to spegliessen or franklinite, and resists any attempt to operate upon it with the hardest steel. **J. H. Ambruster. Philadelphia.**

It is quite within the range of possibility that this product may yet be applied to more important purposes than sash weights. The industry of the exhibitor was highly commended.

CLASS 284.

A very great variety exists in the different articles grouped under the head of Class 284.

The remarks are confined to the following sub-classes; viz., bolts and nuts, screws and nails, horse-shoes, bells, and anvils, &c., and safes.

Bolts, Screws.

There was a particularly good representation of these articles, some of the cases containing thousands of specimens. Probably the point which most

Cold punching applied in the manufacture.

attracted attention was the surprising manner in which cold punching had been applied in the manufacture of nuts. Specimens cold punched were shown with a hole of ½″ diameter through a nut of nearly 2″ depth. The cleanness of the perforation was perfect, and showed that the doctrine of the flow of solids so well expounded by M. Tresca is beginning to bear fruit. The material of the punches used must have been excellent, and time for the material of the nut to move must have been fully allowed.

Hoopes and Townsend, Philadelphia.

The extensive exhibit of Hoopes and Townsend, Philadelphia, contained almost every size and form of bolt and nut, car forgings, cold punched nuts, all manufactured from the best brands of refined iron, and with the best workmanship.

Elevator and Carrier Chains.

There was included a collection of Elevator and Carrier Chains with punched links. In the manufacture of such chains it is necessary to see that equal strength is given throughout the various parts of the link, and it will be well for those interested to study the account of the recent experiments which have been made with the view of determining very exactly the strength to be given at the eyes of the links.

Patent Bolt and Nut Co., Birmingham.

The Patent Bolt and Nut Company, Birmingham, exhibited an immense number of bolts, spikes, rivets, clench rings, &c. Some of the specimens were sawn through the centre longitudinally to show the fitting of the bolt and nut; this was a fine display.

Pierre and Nicholas Nicaise, Marcinelle.

Messrs. Pierre and Nicolas Nicaise, Marcinelle, near Charleroi, Belgium, showed bolts and nuts, as well as forged rivets and clamps for railway purposes. These articles were well made, and the material was of high quality.

Screws and Nails.

American Screw Co., Providence, R. I.

The American Screw Company, Providence, R.I., presented a very extensive collection of steel, iron, and brass screws for every purpose, from ¼ inch to 5 inches in length. The importance of this display may be estimated from the fact that 3,000 varieties were exhibited, all manufactured from excellent material, and in every respect meritorious. The gimlet-pointed screws particularly attracted notice for the efficiency of their design for penetration, and the steel screws were especially good.

Pillow, Hersey, and Co., Montreal.

Pillow, Hersey, and Company, Montreal, exhibit brads, spikes, and nails in endless variety and kind suitable for general use. The fine quality of the iron and the workmanship were highly commended.

Celestin Carmoy, Paris.

France sent a beautiful display of decorators' nails and ornaments manufactured in brass, steel, and bronze. The exhibitor was Celestin Carmoy, Paris. The numberless varieties submitted were very tastefully designed and beautifully executed. The French nation seem to have had, and even now to maintain, a superior power in the artistic design and production of such articles as are above referred to.

Horse-shoes.

Improvements, due to increased value of horses, and more liberal ideas as to treatment.

Probably nothing was better represented than the manufacture of horse-shoes. The world has come to see that there is much to be done in improving the horse-shoe, at least very much beyond the point reached 20 or 30 years ago. The increased value of horses, and the more refined ideas of what our treatment of animals should be, have together resulted in much attention being paid to shoeing. While in our own country Mr. Fleming has probably led the way to improvement, in America many minds have been studying the subject. It is thus that we find at Philadelphia a grander collection of horse-shoes, both as regards finish and variety, than has at any previous time been presented to the world. To bear this out it may be stated that one American firm produces weekly 600 tons of shoes, and another from 200 to 250 tons.

H. Burden and Sons, Troy, N. Y.

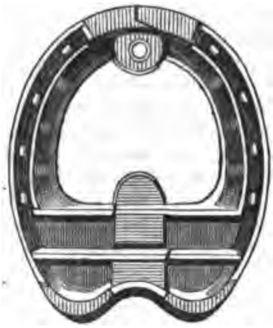
Messrs. H. Burden and Sons, Troy, New York, exhibited a large number of horse and mule shoes. They were machine made, the insides of the shoes very properly hollowed out with correct form. Some specimens were tested for quality, and the material found to be the best Port Henry iron. This was a very superior exhibit.

The Rhode Island Horse-shoe Company, Providence, R.I., sent a collection of machine-made shoes of selected scrap. They were particularly noticed on account of their smoothness and excellent finish. Rhode Island Horse-shoe Co., Providence, R. I.

S. S. Putnam and Company, Neponset, Mass., show hammer-pointed horse-shoe nails, very clean, and made of superior quality of iron. S. S. Putnan and Co., Neponset, Mass.

The National Horse-Nail Company, Vergennes, Vermont, display different varieties of machine-made horse-shoe nails, both plain and polished. They were uniformly well made, and found to be of excellent quality. National Horse-Nail Co., Vergennes, Vt.

Aaron W. Smith, Manchester, N. H., exhibited a flexible horse-shoe for the relief and cure of contracted or flat feet. The shoe is formed with a joint at the toe. Aaron W. Smith, Manchester, N. H.



From the number of certificates of cures effected by the use of these shoes it was apparent that they are very efficient. The style in which the shoes were made was very creditable.

Messrs. Hotchkiss's Sons, Bridgeport, Conn., claim to have the largest and most complete selection of curry-combs. Their exhibit undoubtedly showed great numbers and varieties, with open and close backs, plain and ornamental, with from 5 to 8 bars, and several with the mane and curry-comb combined. This display evinced great care and study in the production of the articles. Hotchkiss's Sons, Bridgeport, Conn.

Bells.

Gong Bell Manufacturing Company, East Hampton, Conn., exhibited a case of polished bells for hand, call, and sleigh bells; also a stand of gongs, of which several were mounted. The examples were beautifully finished, and excellent in tone and quality. Gong Bell Manufacturing Co., East Hampton, Conn.

Bevin Brothers Manufacturing Company, East Hampton, Conn., exhibited a large assortment of the same class of goods, of very creditable workmanship. Bevin Brothers, Manufacturing Co., East Hampton, Conn.

Vanduzen and Tift, Cincinnati, Ohio, exhibited several examples of bells for churches and gongs of clear tone and of good workmanship. Vanduzen and Tift, Cincinnati, Ohio.

Anvils.

Messrs. Fisher and Norris, Trenton, New Jersey, exhibited anvils of a rather novel construction, being cast iron for the body and faced with steel. The process of the manufacture of these articles is essentially American. The difficulty of welding large masses of wrought iron to the steel face (which has been generally the plan followed) has been got over by the introduction of cast iron. The examples shown were of considerable weight. The steel face was sound, and appeared to be completely united to the iron. On the polished surface there was no appearance of crack or flaw. The exhibit was highly commended. Messrs. Fisher and Norris, Trenton, New Jersey.

An immense number of manufactured goods were shown by Benedict and Burnham Manufacturing Company, Waterbury, Conn. This exhibit is mentioned in order to refer to the great excellence of the rolled sheets of brass, copper, and german silver. These plates were of large size, and the surfaces were so fine and perfect that they acted as reflectors. This company also had some specimens of chain which were much admired for their clean manufacture. Benedict and Burnham Manufacturing Co., Waterbury, Conn.

Burglar and Fire Proof Safes.

Early history of the safe manufacture.

Wooden chests.

It may be useful to glance at the early history of the safe manufacture. Strong wooden boxes, bound with iron hoops, which with the locks and padlocks for securing the lid were often engraved or otherwise ornamented, formed the first type of safe. A fine specimen of the old wooden chest is preserved in the Cathedral of Chichester, and is still in an excellent state of preservation. It is 9 feet long by 2 feet wide by 2 feet high, with a thickness of about 2 inches, and is thought to be about 1,000 years old. It may be interesting to note that one of these strong chests was considered sufficiently safe and secure to contain the ancient Regalia of Scotland until it was opened in 1818, and its valuable contents deposited in the Crown Room, Edinburgh Castle.

Chest 1,000 years old.

Scottish Regalia case.

Wrought-iron chests beginning of last century.

Wrought-iron chests were used in the store rooms of country mansions about the beginning of the present century. They were generally of foreign manufacture, made of plates of hammered iron, bound by horizontal hoops round the sides and ends, and crossed by vertical hoops of the same size round the bottoms and sides. The whole of the pieces were firmly rivetted together. The lid to which the lock was generally fixed was made up in the same manner, and fixed by strong hinges rivetted to the inside; the locks had sometimes as many as 8 spring bolts which were moved by the key simultaneously from the centre of the lids. The workmanship of these chests may be now thought rude when compared with the more recent inventions, but the ingenious construction of the lock-work, and the ornamental cutting out of the back plate, show a good knowledge of smith work, and prove the existence of a high art education in the workman beyond what is now possessed by those engaged in the same occupation.

Carron Company, Scotland.

Coalbrookdale Co., England.

At the end of last century the Carron Company in Scotland, and the Coalbrook Dale in England, had introduced cast-iron chests and book safes with single and double doors. These boxes were cast in one piece, about half an inch in thickness, and doors formed in one casting of the same average thickness. The double doors were fixed by two spring bolts and strong wrought iron hinges, and the locks were made the full size of the door, with patent cases of wards and double bolts. This style of safe remained in general use until it was abandoned on account of affording no security in case of fire; but it is interesting to us as forming a transition from the old chest and the improved burglar and fire proof safes which were afterwards adopted.

Manufacture at first confined to London and Wolverhampton.

The manufacture of wrought-iron safes was almost entirely confined to London up to 1830, though some were made at Wolverhampton, and in the neighbourhood.

Thomas Milner.

About 1827 Thomas Milner commenced to make safes with outer cases of strong tin plate and sheet iron, with an inner lining of the same, forming a chamber all round for the reception of a non-conducting substance composed of hard wood sawdust mixed with alum. In case of a fire the action of this composition was, that the alum melted and by damping the sawdust prevented the conduction of heat to the interior of the safe. This may then be considered our first fire-proof safe. Within a few years 5 patents were taken out by different persons for improvements. Most of these patents had reference to the construction of the interior chamber, and to the special composition of the non-conductor, while in the general form and strength there was little variety. These safes were understood to be fire-proof only, but not burglar proof. Doubts were entertained whether even the fire-proof composition was efficient, and it was agreed that means should be taken to prove the efficiency of the articles by public trials. These trials were in their results most satisfactory.

First fire-proof safe.

Public trials.

International Exhibition, 1851.

Since the International Exhibition of 1851, considerable advance has been made in safe manufacture, not only in the United Kingdom, but in France, and especially in the United States. Still, the increased strength of the materials of which safes were made has naturally prompted the inventive faculty of the burglar to discover means to overcome the difficulties in his path, and, in addition to the usual method of forcing the door by the introduction of wedges so as to clear the bolts, recourse was had in some cases to gunpowder carefully introduced into the interior of the lock by the key-hole in such quantity that on being exploded the door was forced out. The idea

Burglars and their processes

of using explosives was a fortunate one for the thieves, and numerous devices were adopted to prevent the admission of these substances into the lock. **Precautions.**

Steel keys requiring a very small opening were also introduced, and the large bolts were moved by a handle on the door, and when thrown were secured by the bolt in the small lock.

In 1855, a patent was taken out by Mr. George Price, Wolverhampton, for case-hardening the door and outer shell of his safes, and for filling the case of the locks so far as possible by small cells of iron. Still it was found that the case-hardening could be taken out by the blow-pipe, and the skin of the safe thus be left ready for the action of the drill. Several robberies of a daring character which took place shewed that there were still weak points in the casing of the safes, as it could be opened by drilling. **Mr. Geo. Price, Wolverhampton.**

Mr. Samuel Chatwood, to render boring impossible, obtained a patent for constructing safes with a quantity of spiegeleisen poured in in a molten state, filling the chamber between the outer and inner cases; to this we shall refer hereafter. Still in our country there has been a too conservâtive clinging to old shapes and ideas, and if the Philadelphia Exhibition did nothing more than show in how many varied ways the same principles of construction may be carried out, and what varieties of form and æsthetics may be introduced in the manufacture of such a prosaic thing as a safe, it could not be considered to have been altogether barren in results. **Mr. Samuel Chatwood.**

The group exhibited in the United States department showed a great variety of form and ingenuity in construction, and was an important object of attraction.

Amongst the safes exhibited, the most prominent in novelty was the Spherical Burglar Proof Safe, of which there were three examples manufactured by William Corliss and Company, of Providence, Rhode Island. **Corliss Safe Co., Providence, R. I.**

Construction.

The outer shell is spherical, about 4 ft. in diameter, and 5 in. thick; the skin of which is chilled 1½ in. deep. The door forms a portion of the outer shell when closed, and is attached to a spherical lining, which revolves on a spindle internally in the centre of the outer shell, and on this spindle wheelwork (protected by a brass box covered over with hardened steel plugs) is fixed.

This wheel work is acted on by a crank handle through an opening in the door.

Operation.

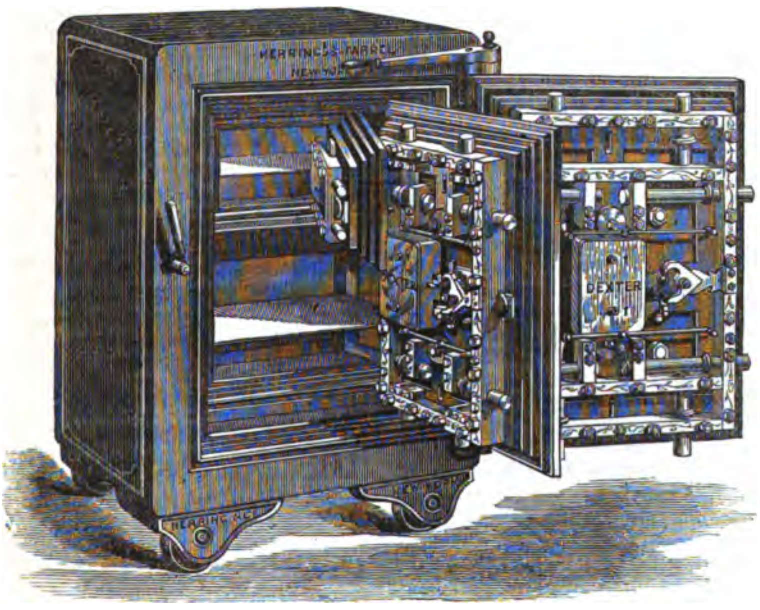
In opening the safe, combination locks which are fixed on the door must be set at their proper position before the handle can move the wheelwork by which the door is drawn inwards so as to permit the opening in the inner case to be turned round to the front. The interior is fitted with shelves and drawers, but the available space is too limited to contain business books; but for money, jewellery, or such property, there is every convenience and security. This exhibit attracted great attention on account of its novel and ingenious construction, as well as for its strength and security. Still, however secure a safe of this description may be considered, yet, owing to its limited capacity, it cannot supply the necessities of great banking establishments and public institutions where large accommodation is required.

Beard and Brother, St. Louis, Mo.

Messrs. Beard and Brother, St. Louis, Mo., are the inventors of an exhibit of

burglar proof safes, which differs from the general form in construction. The novelty consists in the manner of securing the door. In single safes the outer case is constructed in the form of a cube with a lining made up of layers of steel and iron strongly joined together by screws throughout. The steel plates are hardened, and are proof against the action of drills or any other cutting tool. The front is made up in the same manner, and has a circular central opening of sufficient diameter to afford convenient access to the interior. This door is of considerable thickness, made up of welded iron and steel plates combined, and is firmly secured by strong steel conical bolts. The door being circular, has a strong double-threaded screw on its edge, by which it is rotated in closing and in opening like the breach of an armstrong gun. A corresponding screw is cut in the circumference of the opening in the door, and is accurately ground in the front of the safe. In order to handle the door conveniently, it is connected by an ingenious arrangement with an upright spindle and jointed levers, by which it is moved round when shutting parallel to the opening, and when there it is screwed home by a double handle passing through the centre of the spindle. The door is securely fixed by a combination attachment on the front of the safe. **Construction.**

The exhibit of Herring and Company, New York, is important. They have **Herring and C., New York.**



introduced welded angles in their cases; these angles are rounded. They have also introduced a rim on the inner edge of the doors, which, fitting into a grove in the frame filled with india rubber band, prevents the door from being wedged, opened, or powder being introduced. There are also many other exhibits of smaller size with much varied construction, all of excellent workmanship. **Door impenetrable.**

Generally there has been marked progress and improvement shown in the manner in which the shells are now armed and rendered impenetrable.

In addition to the improvements in the internal construction of the cases, there have been added combination and chronometric attachments to the bolts connected with the doors of safe. The latter are the most important, and are fixed in the lock case so that they cannot by any means be tampered with from the outside. Until the hour at which it is desired to open the safe, the clockwork which is wound up and set when the safe is closed, refuses to allow the bolt to be withdrawn. **Safe locks with combination and chronometeric attachments.**

To prevent any injury by violence used on the door, the clock is secured to the lock case with screws having small elastic cushions on which it rests, an **Method to prevent injury**

to clock from violence.

arrangement which has been found efficient, no jarring having had any influence in the progress of the movement after a severe test while in working order. To ensure the utmost advantage of the chronometer lock, they are made double, having two separate and independent movements. The workmanship of these attachments is extremely perfect.

Yale Lock Manufacturing Co., Stamford, Conn.

A very fine example of this lock is shown on an enlarged scale in the exhibit of the Yale Lock Manufacturing Company, Stamford, Conn.

Sargent and Greenleaf, Rochester, N. Y.

Messrs. Sargent and Greenleaf, Rochester, N.Y., exhibit fine double chronometer bank locks of superior workmanship.

Hall's Safe and Lock Co., Cincinnati.

Hall's Safe and Lock Company, Cincinnati, have also sent specimens of chronometric safe locks which fully maintain the high reputation they have acquired in the United States. The vaults of Hall's Safe and Lock Company, and of Messrs. Herring, Sabret, and Sherman, New York, are structures of great strength and security in the sides and roof; they are fitted with two strong doors similar to those on the best safes, with the usual attachments, also, an inner skeleton door for ventilation. These vaults are of great weight and of excellent workmanship throughout.

Chatwood, Bolton, Lan.

Chatwood, of Bolton, Lancashire, exhibits an assortment of his ordinary fire-proof safes, made upon the principle with which his name is associated of T-girder frame on the body of the safe, and solid flange lock-case to the door. The shell is of wrought iron, dove-tailed at the corners by one inch dove-tails, and strengthened by angle-iron corner pieces. The lock-case is formed by securing a frame of angle or T iron to the door, in such a manner as to form a part of the door itself. One side of the angle or the table of the T is rivetted and screwed to the plate of the door, the web being a distance from the edge equal to the width of the projecting web of the T frame, so that when the door is closed the solid flange lock-case rests upon the projecting web of the T frame, and the projecting web on the door just passes the edge of the projecting web of the T frame, and forms the frame of the main lockwork. The bolts passing through it and under the web of the T frame give great rigidity.

These safes are made fire-proof in the usual manner. He also exhibits steel inner safes for cash from two to three inches thick, of solid cast steel, except the door, which is formed of conically intersected steel, two inches thick.

Chatwood's Dextuple Patent Invincible Intersected Steel Safe.

Construction.

Chatwood's Dextuple Patent Invincible Intersected Steel Safe, a third style of safe, is built up of two separate shells of soft steel, each $\frac{5}{8}''$ thick, dove-tailed at each corner, and strengthened by angle frames. The outer shell has its inner surface entirely covered by conical indentations, the point of the cone almost piercing the outer skin. The inner shell has fitted within it a T to receive lock-case of the door. The outer shell is $2\frac{3}{4}$ inches larger than the inner one. The shells are fixed to each other with a clear space of $\frac{3}{4}$ inch between the two, the front edge being made good by a T frame, the web of which is equal to the space between the shells. This compound safe thus forms a mould, which after being expanded by heat (to prevent unequal contraction) is filled with molten speigeleisen, which not only fills the $\frac{3}{4}$ in. chamber between the shells, but also the conical holes of the outer shell, rendering it impossible to cut away the soft steel plate. The impossibility of cutting away the soft steel protects in its turn the crystalline speigel from being broken away. The door of this safe which is made of two soft steel plates, has a curvilinear edge, fitting into a curvilinear seating in the T frame of the safe, and is provided with a solid flange lock-case, having dove-tail claw bolts on all sides, which on the closing of the door pass through openings cut out of the projecting web of the T frame of the safe, and by a turn of the handle the dove-tail heads of the bolt pass into dove-tail grooves planed out of the back of the web to receive the sliding claw bolts of the door, thus practically dove-tailing the door and sides together. The key-hole to the lock is most ingeniously protected. Messrs. Chatwood have in their collection, the

Challenge Safe.

Challenge Safe of the Paris contest. The safe is sent as it was left at the end of the contest at the Paris Exhibition, from which it emerged so satisfactorily.

Limited number of European safe exhibits.

Samuel Chatwood and Co.

It is not easy to assign a reason for the limited number (35 in all) of safes that have been forwarded from European Manufacturers. Samuel Chatwood and Company are the sole representatives of Great Britain, and although their safes are not finished externally in the same tasteful manner, and have not the

same appearance as the American safes, still their quality is undoubtedly first class, and this country would have found it impossible to have been more satisfactorily represented by any one firm.

B. Haffner, Senr., of Paris, exhibits a small number of well finished safes, principally fire-proof, but constructed of a lighter form than the American safes. They are conveniently fitted up internally, the doors and locks are well fitted and secured by combination locks and bolts, they are tastefully finished externally, and were marked "sold." One exhibitor from Belgium, one from Sweden, J. F. Buckman, Stockholm, and one from Norway, Thos. Moestue & Co., Christiania, complete the list of Old World representatives. Their safes require no particular mention.

B. Haffner, Senr., Paris.

Belgium. Sweden. Norway.

From Canada, Mr. Godefroi Chapleau, of Montreal, sends a safe of very creditable construction, with thick non-conducting chambers, filled with plaster of Paris, and the door closed by a double lock, throwing 10 bolts.

Canada, Godefroi Chapleau, Montreal.

It will be seen that the number of American exhibits largely exceeds that of all the other countries put together, and it will be well for our manufacturers to note some of the improvements above described, which are exemplified in the American safes.

In the United States there is apparently a greater demand than we have in England for articles giving perfect security from robbery, and though in this country we may congratulate ourselves that we have, as a long established nation, arrived at a more satisfactory state of society as regards security of property, still if our safe manufacturers are to dispute the markets in foreign countries, they must adopt such styles of articles as time has shown best suited to the varied circumstances of the case in different places.

Concluding Remarks.

It would be foolish not to recognise the fact that at Philadelphia, Great Britain was in face of her most powerful rival in manufactures.

Of course America was at home, and it was to be expected that her portion of the Exhibition would be more complete than that of any other country. One thing however was particularly striking, namely the bright polish of the American exhibits in the Main Building, especially in the cutlery and edge tool department. Americans were determined to show the world that they were in earnest not only to produce articles of first class quality, but also that these articles should be attractive.

America the most powerful rival of Great Britain.

Daintiness of American display.

With reference to the classes referred to in this report it must be allowed that in table cutlery, tools, and safes, America was before Great Britain.

America ahead in table cutlery, tools, and safes.

A strenuous effort will be required from Sheffield to hold its own in the race of progress. The necessary knowledge exists; what is required is a thorough co-operation between masters and workmen, a result which will be arrived at only from a complete understanding of the elements of political economy. In all trade difficulties and disputes, the general view of the question as it affects the community should be considered as well as those narrow and more special views that directly affect either masters or workmen.

Necessity of co-operation between masters and men, in view of lock-outs and strikes.

There seems to be much attention paid in America to the manufacture of tools, and the advertisements in the periodicals of the day bear constant testimony to the attempt which is being successfully made to introduce American tools into Great Britain. In our own country the *principle* involved has too often been overlooked, and probably those interested could not do better than study the series of Cantor Lectures delivered by the Rev. A. Rigg in 1875 on this subject. In these lectures the scientific reasons for the shapes of tools are investigated in a clear popular manner.

Cantor Lectures, 1875.

In safe manufacture America is most active, which is to be explained by there being doubtless more demand for the class of safe manufactured there than we have in England; still it is to be hoped there may be found in the American developments lessons for ourselves.

The night of dulness in trade has not yet cleared off, but the streaks of dawn are beginning to appear. Let us see that in Great Britain at least, we are ready to enter into the competition in manufacture with determination to maintain high quality and correct form, never forgetting the national importance to us of a recognised superiority in our manufactures.

Before closing the above very imperfect Report I desire to make reference to the following gentlemen, with whom I had the pleasure to be associated as one of the Judges of Group XV., namely,—

Judges, Group XV.

DANIEL STEINMITZ, President, Philadelphia, Pa., U.S.
JULIUS DIEFENBACH, Secretary, Germany.
HON. JAMES BAIN, Lord Provost, Glasgow, Gt. Britain.
CHARLES STAPLES, Junior, Portland Maine, U.S.
GENERAL JOHN D. IMBODEN, Richmond, Va., U.S.
GEORGE L. REID, Clearfield, Pa., U.S.

I beg to express my acknowledgments to my colleagues individually for the uniform kindness and courtesy which I experienced from them, and for the general harmony that prevailed in all our deliberations.

Envoi.

To myself, a perfect stranger to the country, this was very gratifying, and impressed me favourably with the genial character of my colleagues, which I shall not soon forget.

DAVID Mc HARDY.

Cranford, Aberdeen, N.B.

Major W. H. NOBLE, R.A.

MILITARY AND SPORTING ARMS, WEAPONS, &c.

REPORT on MILITARY and SPORTING ARMS, WEAPONS, &c. shown at the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By MAJOR W. H. NOBLE, R.A., late Associate Member of the Ordnance Select Committee, and Second Officer of the Experimental Branch at Woolwich.

THE articles which were exhibited under the above heading at the Centennial Exhibition consisted of military and sporting arms, apparatus for hunting, explosives, &c., arranged in the following classes under Group XVI. Group XVI. Class 265, 266, 267, 268, 269, 270, 204, and 206.

Class 265.—Military small arms, muskets, pistols, and magazine guns, with their ammunition.
Class 266.—Light artillery, compound guns, machine guns, mitrailleuses, &c.
Class 267.—Heavy ordnance and its accessories.
Class 268.—Knives, swords, spears, and dirks.
Class 269.—Firearms used for sporting and hunting; also other implements for the same purpose.
Class 270.—Traps for game, birds, vermin, &c.
Class 204.—Explosive and fulminating compounds, in small quantities only, and under special regulations, shown in the building only by empty cases and cartridges. Black powder of various grades and sizes. Nitro-glycerine, and the methods of using and exploding it. Dynamite, dualin, tri-nitro-glycerine, &c.
Class 205.—Pyrotechnics for display, signalling, missiles.

The judges charged with examining and reporting upon this group were:— Judges, 6.
Major-General H. L. Abbot, U.S. Army, President, Willett's Point, N.Y.
Major W. H. Noble, Royal Artillery, Secretary.
Colonel S. C. Lyford, U.S. Army, Chairman, Government Board, &c.
Captain L. P. Saldanha da Gama, Brazilian Navy.
Captain Comdt. Alphonse Lesne, Belgian Artillery.
Mr. George A. Hamilton, St. Paul, Minnesota.

UNITED STATES.

Government Building. Engineer, Ordnance, Quartermaster, and Signal Bureaus, U. S. War Department. Bureau Ordnance, Navy Department.

The United States Government exhibit under Group XVI. was arranged in the "Government Building," and included articles furnished by the Engineer, Ordnance, Quartermaster, and Signal Bureaus of the War Department, and the Bureau of Ordnance of the Navy Department.

Catalogue of exhibits by Lieut. Henry Metcalfe, U.S.

A full descriptive catalogue of the exhibits of the Ordnance Department has been prepared by Lieut. Henry Metcalfe, U.S. Ordnance corps, under whose able superintendence this section was arranged, but owing to its size it has not yet been printed; a short report, however, on the subject, by Lieut. Metcalfe, is given in Appendix F. of the report of the Chief of Ordnance for 1876.

Specimens of ordnance and projectiles.

Characteristic specimens of all kinds of heavy ordnance, both service and experimental, were mounted outside the building in such a manner as to best illustrate the guns, the carriages, and machines for moving and lifting them. Near each gun were exhibited specimens, both fired and unfired, of the principal projectiles used with it.

Rifled siege and field guns. Breech-loading field pieces. Sutcliffe. Moffat. Mann. Hotchkiss and mountain Hotchkiss. Woodbridge.

Within the building were sample cartridges for each gun, filled with imitation powder. The rifled siege and field guns were represented by the 4½-inch and 3-inch guns mounted on iron carriages. A number of breech-loading field pieces were also exhibited within the building, resting on skids upon a massive table,—these comprised the Sutcliffe 3·15 inch, Moffat 3.07 inch, Mann 3 inch, Hotchkiss 3·15 inch, Woodbridge 2·5 inch, and mountain Hotchkiss 1·63 inch. There were also a number of old guns and weapons of historic interest.

Table of details.

The following table furnishes the details of the most important guns.

Dimensions.	20-inch Smooth-bore.	Thompson 12-in. Breech-loading Rifle.	Woodbridge 10-in. Muzzle-loading Rifle.	Sutcliffe 9-inch Breech-loading Rifle.	Mann 8·4-inch Breech-loading Rifle.	8-inch Converted (Palliser) Muzzle-loading Rifle.	13-inch Sea-coast Mortar.	4·5-inch M. L. Rifle.	3-inch M. L. Rifle.	Parrott 3-in. M. L. Rifle.
Total weight - lb.	115,100	84,280	30,300	44,800	20,000	16,160	17,120	3,450	820	890
Length of bore - in.	243	192	155	143	144	117	35	120	65	70
Calibre - - in.	20	12	10	9	8·4	8	13	4·5	3	3
Number of grooves	—	7	19	36	11	15	—	11	7	3
Feet in one turn -	—	70	50	45	60	40	—	15	11	10
Projectile - - lb.	1,080	600	400	280	168	180	200	30	10	10
Charge - - lb.	200	120	70	45	30	35	20	3·25	1	1
Powder, kind -	Hex.	Hex.	Hex.	Hex.	Hex.	Hex.	Cannon	Cannon	Cannon	Cannon
Muzzle velocity - ft.	1,386	—	1,350	1,417	1,406	1,411	—	1,280	1,232	1,233

The experimental guns.

The experimental guns in the above table are the Thompson, Woodbridge, Sutcliffe, and Mann breech-loading rifled guns, and the 8-inch muzzle-loading Palliser rifle.

The Thompson Gun.

The Thompson Gun.

This gun consists of a cast-iron body of the usual Rodman model, embracing, by a slight shrinkage, a steel tube of uniform thickness (1¾-inch). The tube extends through the bore, and is secured at the breach end by a screw thread.

The rear end of the tube is smooth-faced and abuts against the breech-block.

Method of working breech-block.

The latter works in a slot at right angles to the bore; it is circular in section, and is rolled laterally to and fro into position for loading and for firing by a system of cogs and toothed rack. The power is applied by lever arms attached to a spindle, which is secured to the centre of the block, and extends through the breech of the gun to the rear. The closing apparatus is fitted with a cam arrangement, by which the faces of the block and the tube are forced in contact as the breech is closed, but there does not appear to be any provision for locking the breech in position after it has been closed.

Cast and finished at South Boston Foundry. Tube from Bochum Steel Company, Prussia.

This gun was cast and finished at the South Boston Foundry, the tube being supplied by the Bochum Steel Company, Bochum, Prussia.

Trials.

On the completion of the gun, it was sent to Sandy Hook, where it fired two rounds under the direction of the ordnance board. It was then forwarded to the Exhibition at Philadelphia, and since the close of the Exhibition it has been returned to Sandy Hook for further trial. The proposed charge is 120 lb. of hexagonal powder, and a 600 lb. Butler projectile, but in the preliminary rounds the charges were only 30 lb. and 40 lb.; giving respective muzzle velocities of 716 and 786 feet.

Woodbridge Gun.

The Woodbridge Gun.

The Woodbridge muzzle-loading rifled gun was constructed in the Frankford Arsenal, and consists of a thin steel barrel, strengthened by wire wound on its exterior surface, the barrel and wire being subsequently consolidated into one mass by a brazing solder melted into the interstices.

Its fabrication is thus described by Dr. Woodbridge in a letter to the Chief of Ordnance:

"Square wire is wound upon a steel core somewhat larger than the intended bore of the gun, a sufficient number of wires being wound at once, side by side, to produce the required obliquity of the turns. The successive layers have opposite twist, their number being of course sufficient to give the exterior desired diameter to the gun. When thus wound the whole mass is inclosed in a tight case, to protect it from oxidation, and is heated therein to a temperature somewhat above that required for the fusion of the metal to be used for consolidating it. The soldering metal is then run in, filling all the interstices of the mass. When properly cooled the gun is bored and finished from the mass in much the same way as if it were a common casting." **Details of fabrication.**

The Woodbridge system appears to have been first mooted in 1850. **Date of system.**

In 1865 a trial was made of a 2½-inch Woodbridge gun, which demonstrated abundance of strength and endurance. This successful trial led in 1872 to the manufacture of the present 10-inch gun; the work, which presented many difficult problems, owing to the novelty of the construction, was carried out at Frankford Arsenal under the superintendence of Colonel Treadwell and Captain Prince of the Ordnance Department, assisted by Mr. J. H. Gill, the practical foreman in charge. The gun was finished in April 1876, and immediately removed to the Exhibition grounds; it has not yet been tested by firing. **Trials.**

Sutcliffe 9-inch Gun.

This gun consists of a cast-iron body of the usual Rodman type. The tube was supplied by the Bochum Steel Company, and was forged from a single ingot, it was inserted from the breech by hydraulic pressure, and is of a greater exterior diameter throughout the lower or breech half of its length. It is thus secured from being thrust forward under the action of firing by a shoulder formed by the bevelled junction where the thicker part of the tube abuts against the casing, and also by a muzzle screw collar somewhat similar to that used in the manufacture of Palliser guns. **Sutcliffe Gun. Details of construction.**

The breech-mechanism works in the cast-iron casing, and is independent of the steel tube. It consists of a breech-block capable of rolling back into a slot in the casing, and a hollow breech screw which is attached to the block, near its edge, by a pin. The block is free to turn on this pin as on a pivot, and only once during a revolution are the block and breech screw concentric. The block is fitted with a steel plate which abuts against a Broadwell ring. The breech screw is moved by a handle, rack, and pinion arrangement in rear. The tube was inserted from the breech end by means of a powerful hydraulic press, the final adjustment or "setting home" being accomplished by a few rounds of from 30 to 40 lb. of powder and 220 lb. shot. **Working details.**

Up to the time of its being sent to the Exhibition the gun had fired 26 rounds, the charges varying from 30 to 40 lb., and projectiles from 217 to 250 lb. **Number of trials.**

Mann Gun.

This gun is of cast-iron, reinforced over the breech by wrought iron exterior bands. The breech mechanism belongs to those systems in which the breech block remains stationary, and the body of the gun is made to revolve upon its trunnions the necessary degree to open and close the breech. **Mann Gun.**

In loading the breech screw is loosened, and the crank handles turned until the gun, revolving on its trunnions, assumes a position in which the chamber is sufficiently exposed above the breech block for the insertion of the charge. The gas check ring is then removed, and the shot and cartridge inserted. The gas check is now replaced, the crank reversed until the gun is restored in line with the breech block, and the breech screw tightened up by a lever. **Working details.**

Up to the time of its being sent to the Exhibition this gun had fired 11 rounds, the charges varying from 20 to 30 lb., and the shot being 168 lb., in weight.

8-inch converted Rifled Gun.

Palliser system. By far the most important of the Ordnance experiments carried out of late years by the United States authorities has been the trial of rifled guns converted on the Palliser system.

Reason for experiments. These experiments were undertaken with a view of ascertaining whether the large number of comparatively ineffective smooth bores which now constitute the casemate armament of the United States sea coast defences could be utilized by conversion into rifles; and also to throw as much light as possible upon the system *per se*, in its relation to higher calibres of original constructions.

Trials. The trials were under the supervision of the Ordnance Board, and the success which has hitherto attended them may in great measure be attributed to the foresight and energy of Colonel Crispin, the Constructor of Ordnance, and the other members of the Board.

Guns to be experimented on. When these trials were first authorised, it was decided that four smooth bore cast-iron guns should be converted into rifled guns as follows:—

No. 1. To an 8-inch calibre by the insertion of a coiled wrought iron tube, on the Palliser system, from the muzzle.

No. 2. To an 8-inch calibre by the insertion of a steel tube from the breech.

No. 3. To a 9-inch calibre on the same system as No. 1.

No. 4. To a 9-inch calibre on the same system as No. 2.

No. 1. gun. Rodman 10-inch smooth-bore. No. 1. Gun consists of a 10-inch Rodman smooth-bore, bored up to a diameter of 13·5 inches for the reception of the lining tube of coiled wrought iron, the breech of which to a distance of 32·75 inches is a double coil. The bottom of the tube is closed with a wrought iron cup screwed into the A tube with a *plus* thread; that is the threads on the A tube project beyond the surface of the bore. **Tube.** The tube was manufactured at Sir William Armstrong's works in Newcastle-on-Tyne, and the gun was put together by the method generally followed in England in the manufacture of Palliser guns. **Rifling.** The rifling of the gun consists of 15 lands and grooves, each of equal width (0·831 inches), the depth of the grooves being 0·075 inch. **Twist.** The twist of the rifling is a uniform one of one turn in 40 feet, and the rifling stops at 10 inches from the bottom of the bore. **Powder.** The powder used in the experiments was that known as Du Pont's hexagonal grain, 80 to the pound. **Projectiles.** The projectiles were elongated cast-iron cored shot, with soft metal bases to take the grooves and insure rotation (Butler and Arrick systems). **Weight of charge and projectile.** The weight of the charge was in most rounds 35 lb., that of the projectile 180 lb. **No. of rounds.** Up to the time of its being sent to the Exhibition this gun had fired 761 rounds, and it is still in a sound and serviceable condition.

No. 2. gun. 10-inch Rodman. Tube. No. 2 gun consisted of a 10-inch Rodman gun bored up to sufficient interior diameters for the reception of the steel tube and its jacket. The tube was 2 inches in thickness, and the jacket, also 2 inches in thickness, was shrunk upon the tube and extended from a point a short distance in front of the trunnions to the outer face of the breech. A screw was cut on the base of the jacket and a corresponding thread in the breech of the casing. The tube and jacket as a whole were then forced through the breech into the casing by mechanical means and screwed home, after which a muzzle collar was screwed in. **Rifling, charges, and projectiles. No. of rounds.** The rifling, charges, and projectiles were similar to No. 1 gun. At the 170th round a fine crack was detected extending from the band immediately in front of the vent to the copper bush. In 4 more rounds this crack extended to the muzzle in and through the tube. The firing was, however, continued up to 456 rounds, when the gun burst.

No. 3. gun. No. 3 gun was constructed in a similar manner to No. 1, and conformed to it except in calibre and rifling; the powder was also similar. The charges used were principally 40 to 45 lb., the shot varying from 200 to 250 lb. **No. of rounds.** The gun has fired 500 rounds, and is still perfectly serviceable.

No. 4. gun. No. 4 gun. The description of this gun is identical in every respect with that of No. 2 gun, except that the tube was inserted by heating the cast-iron casing and allowing it to shrink on the tube. The calibre and rifling were the same as No. 3 gun; the charges, projectiles, and powder were also similar. **No. of rounds.** Up to this time the gun has fired about 120 rounds, and is still serviceable.

No. 5 gun. This gun is identical in its construction and dimensions with No. 1, with the exception that its coiled wrought-iron tube was manufactured by Messrs. Paulding, Kemble, and Co. at the West Point foundry on the Hudson River. The powder, projectiles, &c. were in all essential particulars the same as those used in the trial of the 8-inch gun No. 1. No. 5. gun. Tube.

Five hundred rounds have been fired, and the gun is still perfectly serviceable. No. of rounds.

The conclusions drawn by the United States Ordnance officers from these experiments may be summarised as follows : Conclusions drawn by U. S. Ordnance officers.

1. The 10-inch Rodman smooth bored gun can be converted into a rifled gun by the insertion of a coiled wrought-iron tube of American manufacture. The gun thus converted will equal in power the English 8-inch R. M. L. gun of 9 tons, fired with a 35 lb. charge and 180 lb. shot. Firstly.
2. The endurance displayed by the comparatively light 9-inch gun (No. 3) indicates that original constructions on this system of the largest calibres desired can be successfully produced. Secondly.
3. The results, although not affording conclusive evidence as to the most perfect methods of conversions as far as systems are concerned, yet undoubtedly point to the superior quality of coiled wrought-iron tubes over steel tubes for 8-inch conversions. Thirdly.

The United States Government collection of small arms was very extensive, and included 53 specimens of muzzle-loading guns and 154 of breech-loaders, but by far the most interesting feature of this section consisted of a full set of cartridge machines, 19 in number, making 5,000 blank cartridges (0·45 calibre) per day, and 21 machines of a typical character at work upon different parts of the Springfield rifle. U. S. Government collection of small arms.

The Engineer Department of the United States army exhibited some very interesting models illustrative of General Abbot's system of torpedo defence including the trials which have been carried out by that officer at Willett's Point, with a view of developing the subject of submarine warfare. Engineer Department, U. S.

The Quartermaster Department exhibited various machines for the manufacture of military clothing, including a clever machine for soleing shoes by means of metal screw plugs. There was also a very fair display of uniforms, harness, camp equipage, &c. Quartermaster Department, U.S.

The Signal Service Bureau showed a field telegraph train consisting of a battery waggon, four wire waggons, four pole wagons, the whole capable of transporting and working 50 miles of portable telegraph line. Signal Service Bureau, U.S.

The Bureau of Ordnance of the Navy exhibited specimens of the various smooth-bore guns and rifles used in that branch of the service, including the heavy guns in the following table: Bureau of Navy Ordnance.

Details.

Dimensions.			15-inch smooth-bore.	11-inch smooth-bore.	9-inch smooth-bore.	8-inch smooth-bore.	100-pr. Rifle. Parrott.	60-pr. Rifle. Parrott.
Total weight		lb.	42,000	15,700	9,000	6,500	9,700	5,400
Length of bore		in.	146	131	107	96	130	105
Calibre		in.	15	11	9	8	6·4	5·3
No. of grooves			—	—	—	—	9	7
Feet in one turn			—	—	—	—	18	12
Projectile	Shot	lb.	440	166	90	64	—	—
	Shell	lb.	352	138	74	58	96	55
Charge		lb.	100	15	10	7	10	6
Muzzle velocity		ft.	1,560	1,270	1,350	1,330	1,250	1,200

Navy Department.

The Navy Department also showed various specimens of offensive torpedoes, including among others the Lay, which pays out a cable and remains under the control of the operator during its run.

Display by private firms. Remington Co. Colt's Co. Sharp's Co. Whitney Arms Co. Winchester Arms Co. Smith & Wesson. Evans Co.

The private firms of the United States made a fine display of small arms and machine guns. Rifles, revolvers, and sporting arms of excellent quality, were shown by the Remington Company, Colt's Company, Sharp's Company, Whitney Arms Company, Winchester Arms Company, Smith and Wesson, Evans Company, and others. The Colt Company and Evans Company showed novelties in magazine guns. The most prominent machine guns were those of Dr. Gatling exhibited by Colt's Fire Arms Manufacturing Company of Hartford.

Gatling guns.

This celebrated weapon is so well known that it does not need a description, but several important improvements have recently been made in its construction.

Latest model.

The latest model is a five-barrelled gun in which the improvements are as follows:—The crank-handle is attached to the rear instead of the side, thereby increasing the speed of revolution of the gun and the rapidity of its fire; the drum is abolished and a new pattern feed case substituted for it; it stands vertically and thus ensures a direct fall into the receivers; all the working parts, as well as the barrels, are encased in bronze to afford protection from dust and dirt; the arrangement of the locks has been much simplified, and the size of the whole breech arrangement reduced by about one half; the rapidity of fire has been more than doubled; the transversing arrangement has been improved.

Extraordinary firing, 1000 rounds per minute; ordinary, 700 rounds.

This gun has been fired at a rate of 1,000 rounds a minute, but the ordinary rate of rapid firing is about 700 rounds per minute. Fired deliberately at a target 19 feet long by 11 feet high, range 1,000 yards, it scored 665 hits out of 1,000 shots.

FRANCE.

Gevelot.

The French exhibits were confined to a few sporting arms and a good display of cartridges cases by the well known House of Gevelot.

GERMANY.

Krupp of Essen.

The magnificent display of breech-loading heavy and light artillery made by Herr Krupp of Essen has been unequalled by any former Exhibition.

Exhibits. Breech-loading heavy and light artillery.

The exhibit consisted of:—

1. 35·5-centimetre gun mounted on barbette carriage and slide.
2. Long 24-centimetre gun mounted on barbette carriage and slide.
3. 8·7-centimetre field gun with carriage and limber.
4. Ditto with carriage only, finely polished.
5. 7·5-centimetre field gun with carriage and limber.
6. 8-centimetre mountain gun with carriage, pole, and ammunition boxes.
7. 6-centimetre mountain gun with carriage, pole, and ammunition boxes, mounted on mules.
8. Saddles and harness for 6-centimetre mountain gun.
9. A collection of projectiles.
10. Two pressed trail brackets for field gun carriages.
11. Two pressed perches for ammunition wagons.

The following table gives the weight and dimensions of the principal parts of the guns:

Details.

Nature of Gun.	Calibre.	Length. Total.	Length. Of Bore.	Total Weight with Breech Wedge.	Twist of Rifling—one turn in.	Grooves. Number.	Grooves. Width.	Projectiles. Steel Shell. Total Weight.	Steel Shell. Weight of Bursting Charge.	Chilled Shell. Total Weight.	Chilled Shell. Weight of Bursting Charge.	Common Shell. Total Weight.	Common Shell. Weight of Bursting Charge.	Shrapnel Shell. Total Weight.	Shrapnel Shell. Weight of Bursting Charge.	Case Shot. Total Weight.	Charge. Battering.	Charge. Ordinary.	Muzzle Velocity.
	ins.	ins.	ins.	lb.	ins.		ins.	lb.	lb.	lb.	lb.	lb. oz.	lb. oz.	lb. oz.	drms.	lb. oz.	lb.	lb. oz.	feet.
35·5 centimetre	14	315	270·2	126,766	630	80	0·37	1124·5	33·1	1157·6	17·6	904 0	66 2	—	—	—	275	242 8	1,591*
24 centimetre -	9·45	205·9	177·6	23,700	425	54	0·39	341·75	—	355	—	275 8	—	—	—	—	83·75	72 12	1,542*
8·7 centimetre	3·42	82·7	73·9	1,069	154	24	0·32	—	—	—	—	13 11	0 8	15 12	9·5	13 10	—	3 5	1,558
7·5 centimetre	2·95	78·74	70·67	661	133	24	0·276	—	—	—	—	9 4	0 4½	9 7	8	8 11	—	2 3½	1,496
8 centimetre - (Mountain.)	3·15	38·39	33·27	227	118	18	0·42	—	—	—	—	8 13	0 4½	—	—	—	—	0 14	952
6 centimetre - (Mountain.)	2·36	39·37	34·65	198	83	18	0·30	—	—	—	—	4 6½	0 3	—	—	—	—	0 7	919

* With steel projectiles and battering charge.

The carriage and slide of the 35½-centimetre gun are similar to those used for coast batteries. The height of the trunnions when the gun is mounted is 8·76 feet, which allows 6 degrees depression when firing over a parapet 6½ feet in height. The carriage corresponds in construction with the Krupp 30½-centimetre coast carriage which was exhibited at Vienna in 1873. The recoil is checked by two hydraulic brakes. Carriage and slide.

The trial of this gun took place at the proof butts belonging to the Essen works. The velocities were observed with Boulengé's Chronograph and the pressures by a Rodman apparatus placed in the wedge piece. Trial.

The following table * gives the results : Details of experiments.

Krupp Breech-loading 35.5 cent. 13·976 inch Gun. Experiments at Krupp's Works, 27/12, 1875.

Round.	Description of Powder.	Weight of Charge.	Weight of Projectile.	Space occupied by Charge. Length.	Diameter.	Volume. Total.	Volume. Per lb. of Powder.	Observed Velocity at 110 feet.	Muzzle Velocity.	Pressure.	Energy. Total.	Energy. Per inch of the Shot's circumference.
		lb.	lb.	inch.	inch.	Cubic in.	Cubic in.	feet.	feet.	tons.	foot tons.	foot tons.
1	Ordinary prismatic - -	176·4	1157·4	59·568	14·449	9,767	55·37	1205·0	1,209	21·2	11,727	267·1
2	Prismatic powder, with one hole 3·93 in. in diameter, 100 prisms weighing 8·377 lb. -	220·46	1155·2	59·213	14·449	9,709	44·04	1355·3	1,360	17·4	14,833	337·8
3	" "	242·5	1147·5	59·017	14·449	9,677	39·90	1439·6	1,445	18·0	16,609	378
4	" "	264·5	1145·3	58·978	14·449	9,671	36·56	1511·8	1,517	—	18,270	416
5	" "	275·6	1143·1	59·686	14·449	9,787	35·51	1560·7	1,567	24·5	19,457	443
6	" "	275·6	1139·8	59·174	14·449	9,703	35·20	1559·4	1,565	23·0	19,351	441
7	" "	275·6	1145·3	58·663	14·449	9,619	34·90	1560·7	1,567	22·3	19,494	444
8	" "	286·6	1146·4	59·017	14·449	9,677	33·76	1589·3	1,595	25·2	20,217	460
9	" "	297·6	1146·4	59·370	14·449	9,735	32·71	1630·9	1,637	25·9	21,295	485
10	Large grain, from ·984 to 1·181 inch - - - -	297·6	1145·3	59·489	14·449	9,755	32·77	1385·2	1,390	15·9	15,340	349

* Reduced to English measures by Captain Charles Jones, R.A.

Field and mountain carriages.

The field and mountain carriages are constructed with cast-steel pressed brackets with cross joints of cast-steel plates, axle of cast-steel, wood wheels with iron tires and bronze naves.

The field limbers are, with the exception of wheels and pole, constructed of iron.

The 8·7-centimetre limber is arranged to take 32 projectiles, viz., 20 common shells, 10 shrapnel shells, and 2 case shot. The 7·5-centimetre limber takes 38 projectiles, viz., 24 common shells, 12 shrapnel shells, and 2 case shot.

Weights of carriages and limbers.

The following table gives the weights of the carriages and limbers:—

Particulars.	8·7	7·5
	lb.	lb.
Weight of carriage empty - - - -	1,124	1,014
Weight of limber empty - - - -	1,102	1,014
Weight of ammunition - - - -	573	452
Weight of small stores, and - - - -	154	143
Weight of gun - - - - -	1,069	661
Total weight of draught - - - -	4,022	3,284
Draught on each horse in team of 6 - -	670	547

RUSSIA.

Government exhibition.

Berdan system.

The Russian Government exhibition of war material was highly creditable, but in the absence of descriptive catalogues it is quite impossible to do justice to it. Some good specimens of military small arms on the Berdan system were exhibited by the Imperial Russian Rifle Manufactory at Toola, and also by the Rifle Manufactory at Sestoretsk, near St. Petersburg.

Baron Hahn.

A fortress breech-loading rifle of 0·8-inch calibre firing a shot of about 5 ounces with 1 ounce charge was exhibited by the inventor Major General Baron Hahn.

St. Petersburg Cartridge Manufactory.

The St. Petersburg Cartridge Manufactory exhibited a collection of successive parts of cartridge cases and a complete set of gauges for verifying the parts of the Russian rifle.

Dimensions of rifled guns, Army and Navy.

The following table gives the dimensions of the rifled guns exhibited both by the Russian Army and Navy Departments.

Dimensions.		Naval 9-inch Breech-loading Rifle—Steel.	Naval 6-inch Breech-loading Rifle—Steel.	Naval 4-pr. Breech-loading Rifle—Steel.	Army 4-pr. Breech-loads Rifle—Bronze (new model).	Army 3-pr. Breech-loading Mountain Rifle.	Army 8-inch Bronze Breech-loading Rifle Mortar.	Army 6-inch Bronze Breech-loading Rifle Mortar.	Experimental 4-pr. Breech-loads Steel Rifle from Penn works.
Total weight -	- lb.	33,376	8,960	784	1,097	224	8,220	3,000	1,318
Length of bore	- ins.	136	122	60	67	24	54	40	60
Calibre - -	- ins.	9	6	3·42	3·42	3	8	6	3·42
No. of grooves	- -	32	24	12	8	12	30	24	12
Projectile -	- lb.	270	81	12	12	8·8	176	81	13·1
Charge - -	- lb.	47	18	1·3	4	0·75	15·3	6·3	5·0
Powder - -	- kind	Prism	Prism	—	Coarse	Fine	Prism	Fine	Coarse
Muzzle velocity	- feet	1,341	1,335	1,004	1,537	698	826	800	1,676

The Army 4-pounder breech-loading bronze rifle gun of the new model was cast in a metallic mould under pressure on the system proposed by Colonel Lavroff, the bore was also hardened by forcing steel-mandrels through it. A similar method of hardening the bores of bronze field guns was followed by General Uchatius in Austria, and it was proposed and patented in 1869 by Mr. Samuel B. Dean of Boston, Massachusetts. Colonel Lavroff, Russia. General Uchatius, Austria. Mr. S. B. Dean, Boston, Mass.

This gun was mounted upon an experimental steel carriage of the Krupp type devised by Colonel Engelhardt and fitted with a cork buffer of novel description, for checking recoil. It is said that over 1,000 rounds of comparatively heavy charges have been fired from a gun mounted on a carriage of this description with perfect success. Colonel Engelhardt.

The engineer department of the Russian army exhibited some well constructed models of a military bridge equipage, also siege and mining tools and numerous drawings of barrack structures. Engineer department.

SWEDEN.

An interesting exhibit was made by the Swedish War Department. It included specimens of small arms from the Royal Factory at Karl Gustafs Stad; specimen carriages complete of a field battery; and specimens of time and percussion fuses in different stages of manufacture. War Department. Royal Factory, Karl Gustafs Stad.

All the iron work of the field artillery harness, including bits, was galvanized.

The Husqvarna Arms Manufacturing Company exhibited a collection of military and sporting arms; and some excellent specimens of chilled projectiles were shown by the establishments of Karl Ekman and De Maré. Husqvarna Arms Manufacturing Company. Karl Ekman and De Maré.

The models of a military bridge equipage, designed and constructed by Captain V. Norrman of the Royal Swedish fortification corps possessed interest. Military bridge equipage. Capt. V. Norrman.

The equipage is composed of 28 carriages of which 16 are loaded as pontoon or plank wagons, 8 as trestle or bulk wagons, and 4 as train or forage wagons. All these wagons are precisely alike, and are, therefore, interchangeable so far as load is concerned. The wagons, wheels and all, are made of wrought and cast-steel.

SPAIN.

The Spanish War Office had an interesting exhibition of war materials in a building specially devoted to the purpose, but no catalogue of the articles was forthcoming. War Office.

The chief features were beautifully constructed models of fortresses and barracks, specimens of mountain artillery, models of field artillery and pontoon trains, and sword blades of the celebrated Toledo make. Models.

BELGIUM.

The Belgium exhibit under Group XVI. consisted almost exclusively of sporting arms and their accessories. Arms and accessories.

Cheap and excellent gun barrels in various stages of manufacture were exhibited by the firm of Hense and Co. Hense and Co.

BRAZIL.

The exhibition of war material made by the Brazilian Government was illustrative of the great progress which has of late years taken place in the manufacturing capacity and mechanical skill of the Brazilian arsenals. Government display.

The exhibit included small arms, rifled cannon, mortars, models of military carriages, projectiles, fuses, and metallic ammunition.

GREAT BRITAIN.

In the British department no display of Ordnance was made, but the exhibit of sporting small arms was particularly good, and included specimens from the principal makers. Small arms. Private firms.

Mr. Jas. Purdey.

Mr. James Purdey, of 314½ Oxford Street, London, showed some very fine shot guns and express rifles illustrative of his snap action and double lock.

Mr. Alex. Henry.

Mr. Alexander Henry, of 12, South St. Andrew Street, Edinburgh, exhibited admirable specimens of breech-loading express rifles for deer stalking, and for the destruction of all kinds of large and dangerous game.

Messrs. Lang and Son.

Messrs. Lang and Son, of 22, Cockspur Street, London, displayed some very good specimens of their well known self-cocking double breech-loading sporting guns.

A hammerless gun of novel construction was shown by Mr. Westley-Richards.

Messrs. Lancaster, Rigby, Scott, Webley.

Messrs. Lancaster, Rigby, Scott, Webley, and others, were also well represented, and as a whole the exhibit fully maintained the character of British sporting arms.

Messrs. Pigou, Wilks, and Laurence.

An interesting case of gunpowder specimens was exhibited by Messrs. Pigou, Wilks, and Laurence, of Dartford.

W. H. Noble,
Major, R.A.

26th December 1876.

Captain DOUGLAS GALTON, C.B., D.C.L., F.R.S.

RAILWAY APPLIANCES.

REPORT on RAILWAY APPLIANCES at the PHILADELPHIA EXHIBITION. By CAPTAIN DOUGLAS GALTON, C.B., D.C.L., F.R.S. (late Royal Engineers).

SIR,

THE railway appliances exhibited at the Centennial were principally derived from the United States and Canada, and were mustered under Group XVIII., including Railway Plant, Rolling Stock, Engines, &c. Preliminary Remarks.

The Judges for the Group, to which I had the honour of being appointed President, were—

Colonel Robert E. Ricker, Elizabeth, N.J.
General T. A. Morris, Indianopolis, Ind.
Mr. Felician Slataper, Secretary, Pittsburg, Pa.
Mr. Ernest Pontzen, Austria.
Mr. E. Schaar, Belgium.

There were a limited number of foreign exhibits of peculiar merit, such as the signalling arrangements sent from Great Britain, the tyres and axles from Sweden, and the buffers, couplings, and wheels from Belgium; but the main features of the Exhibition were derived from American sources. In this point of view the Philadelphia Exhibition possesses peculiar interest for England, in that it brings into prominence those features in which the American system differs from our own.

It is just 20 years ago since I made a report to the Board of Trade upon the railway system of the United States. This report affords even after the lapse of so many years an accurate representation of the American railway system. The improvements and the developments which have taken place in the system since that time have closely followed the lines which I then pointed out. American Railway System.

The American railway system is the offspring of totally different wants from those experienced in this country. In Europe capital was plentiful; the populations to be accommodated were already gathered into fixed localities; good roads and canals existed; so that the railway was originally looked upon rather as a means of diminishing distance by the use of high speeds than as the universal road for traffic. In America, on the other hand, the railway has been the pioneer road of the country, and the sole means of communication. It has opened out new districts to the settlers, and has caused the growth of new towns, and thus developed the country with immense rapidity. Comparison with European.

The construction of the railway thus led to the absorption of a large capital for developing the country through which it passed; and the high return which the expenditure for such development afforded prevented the investment in a railway of more capital than was sufficient to enable it to perform the work immediately required of it. Thus, whilst the first cost of a railway was small, a considerable expenditure had to be incurred in perfecting the line, in proportion as the requirements of the population it had attracted to its vicinity increased. Simplicity of construction at first. Subsequent improvements.

In a new country certainty of communication is of far more importance than speed, and the rough standard which prevailed in the pioneer lines of railway in the United States entirely answered its object. The more perfected system now at work in the Eastern States has grown out of this rough standard, and the Philadelphia Exhibition affords us a means of tracing out how the improvements which have taken place have followed chiefly in those original lines. Satisfactory results.

Thus the improvements in railways have been in the material matters of the construction of the permanent way, in the engines, and in the comfort of the passengers in the cars, rather than in stations. The early American railways had to be made out of such materials as lay to hand, and out of such money as could be brought together. The sleepers were laid on the soil, there was little or no ballast, sharp curves and steep gradients were the rule, as in order to avoid cuttings the railway generally followed the sinuosities of the ground; and therefore a short rigid wheel base became imperative in the rolling stock. Detailed statement.

Plan of Cars.

To facilitate supervision, and to meet the democratic tendencies of the country, the pattern selected for the car was that of the saloon of a steamboat, instead of being a development of the body of a stage coach which our railway carriages were. The cars are coupled in the central line of the car, so that they may accommodate themselves to sharp curves. The entrance to the car is by means of a short platform with descending steps at the end, which render station platforms unnecessary. Moreover, the body of the car contains conveniences, so that the construction of the expensive conveniences which are erected at English stations are not required there.

Signalling.

In the arrangements of the station, moreover, the signalling has always been in a more primitive condition than with us. Until recently there had not been such a traffic as would require or justify the expensive signal arrangements to which we have recourse. More responsibility seems to be thrown on the engine-driver, or as he is termed the engineer, and therefore the direction of improvement appears to have rather lain in that of perfecting the train appliances, over which the engineer has control, than in developing the accessories to safety on the line itself, which would tend to diminish the responsibility of the officer in charge of the train.

There are so many points of interest connected with the railway system of the United States, apart from the mere mechanical problem which the Exhibition sets before us, that I think I shall better fulfil the object of this report by limiting my account of the exhibits to those which display peculiar qualities, in order to afford space for a brief account of some of the more general problems which have arisen in the American railway system.

Permanent Way.

Pennsylvania Railroad Track.

The Pennsylvania Railroad Company exhibited a section of their standard railroad track. The main feature of the permanent way is in the shape of the head of the rail, the form of splice for the joints, the large number of sleepers, and the arrangement of the ballast. The rails are steel of the Vignoles pattern. They are fished at the joints.

Rails.

Two patterns.

There are two patterns of rails, one of 60 lbs., the other of 67 lbs. per yard.

The 60 lbs. rail is $4\frac{1}{4}$ inches deep, and the 67 lbs. rail $4\frac{1}{2}$ inches. The head of the 60 lbs. rails is $1\frac{3}{8}$ inches deep, and the head of the 67 lbs. rail $1\frac{1}{2}$ inches deep. The splices are 2 feet in length; they are held by 4 bolts, 2 on each side of the joint. The outside splice has a tongue which passes over the flange of the rail and rests on the sleepers to which it is spiked.

Joint.

The joint is suspended midway between two sleepers, placed so as to be 10 inches apart between the edges of the adjacent surfaces. In winter $\frac{5}{16}$ inch, and in summer $\frac{1}{16}$ inch, are left between the ends of the rails to allow for expansion. There are 16 sleepers, 8 ft. 6 in. long, 7 in. deep $\times$ 8 in. wide, to each 30 ft. rail, the sleepers at the joints being placed 10 in. apart, and the others being evenly spaced between, but so that no sleepers should ever be more than 2 feet from centre to centre. The rails are spiked to each tie, both on the inside and outside.

Ties.

Great care is taken to obtain an even bearing surface for the ties, which are not to be notched but if twisted to be straightened with the adze. The subgrade is 31 ft. 4 in. wide for the double road, and is formed with a slope from the centre towards each side, at an inclination of 1 in 20. The ballast is laid to a depth of not less than 12 inches under the sleepers, and is filled up evenly between, but not above the tops of the ties, and at the outer end sloped off to the subgrade. Where stone ballast is used it is broken evenly, and not larger than a cube that would pass through a two-and-a-half inch ring. With double tracks, coarse large stones are placed in the bottom to provide for drainage, but care is taken to keep the coarse stones away from the ends of the ties.

Proportion of Sleepers.

This road as exhibited, and for which an award was given, is the road in use over a large section of the Pennsylvania Railroad. It will be seen that this form of permanent way depends for its solidity mainly upon the large number of sleepers. The surface occupied by timber is nearly as large as that occupied by ballast. Therefore a lighter rail can be used than in this country, and so long as timber continues cheap this permanent way will hold its own. But the destruction of forests in recent years has been so great that this must soon

cease. Another object obtained by this permanent way is that water drains off rapidly, a great matter in the hard frosts to which these lines are subject.

A large amount of ingenuity is expended in the United States upon *nut locks, e.g.*, means for preventing the nuts which secure the fish plates from becoming loose. None have as yet been found of such practical advantage as to obtain universal adoption; nor can it be expected that, with the forces always at work on a railway, anything can be devised which will do away with the necessity for frequent inspection. Nut locks.

An award was given to Messrs. Cammozzi and Schlösser, of Frankfort, A/M., who exhibited in the German Section a very convenient instrument for ascertaining with rapidity inequalities of gauge and of the levels of the rails. The instrument was supported on a light frame on four wheels; when pushed along the rails an index hand shows whether the rails are in true gauge and whether there is any, and if so what, difference in the levels of the two rails. There were some exhibits of crossings which merit notice; a chilled cast-iron crossing was exhibited by the Ankarsrums Works in Sweden for durability, which has been laid at the entrance to a station since 1869, and showed scarcely any signs of wear. Elastic frogs and crossings were also exhibited, *i.e.*, with a layer of caoutchouc, or with wood, under the iron or steel frog to prevent the jar; but they appeared to show ingenuity rather than practical merit. Cammozzi and Schlösser's Instrument to test gauge and level. Ankarsrums Works; Crossings. Elastic Frogs and Crossings.

The switches and points on American railways are universally of the pattern we term contractor's points. The rule on all American railways is to keep all the switches leading off a main line fastened in position by a padlock. In England this form of switch is entirely discarded. The perfection of the points which we use has in itself laid them open to many serious elements of danger, from the possibility of some foreign matter preventing the points from closing. Contractor's Points.

In the Philadelphia Exhibition Messrs. Brierley, Sons, & Reynolds exhibited a method for the mechanical removal of such obstructions, by means of a plate which lies on the level of the surface of the rail between the points when they are open, and is dropped below the rails as the points close. Messrs. Saxby & Farmer, and Messrs. Brierley, Sons, & Reynolds both exhibited a means of locking the points in position. The former pass a bolt through the centre of the bar which connects the pair of points, whilst Messrs. Brierley, Sons, & Reynolds fix the point against the rail by means of a bolt moved up from below. The latter is the more reliable arrangement. Messrs. Brierley, Sons, & Reynolds. Comparison between the systems of working points in position adopted by Messrs. Saxby & Farmer, and Messrs. Brierley, Sons, & Reynolds.

When one looks at the simplicity of the American system of the old contractor's point, it would seem that if as much ingenuity had been bestowed upon a means for locking this description of points when they have been moved into position as has been bestowed upon the points which we have adopted, they would be safer than ours from their very simplicity.

The modification of the form of switch which is most deserving of notice, as presenting features of peculiar novelty, is the Wharton Switch. The principle of this switch is that of carrying the train off the main line on to a siding without any break in the continuity of the main line rails. This is effected in the following manner. The inner switch rail is connected with a moveable guard rail. This connected switch and guard rail is shaped in section like a **U**, and one side terminates in a point which laps under the main rail in the same way in which our points do, and thus guides the wheel, as our points also do, away from the main rail. This throws the opposite wheel close against the other main rail, and causes the outer part of the tread of the wheel to pass on to the outer switch rail from the place at which the tread of the wheel gets a bearing on the outer switch rail. The guard rail and the switch rail are gradually inclined upwards, by this means they raise the wheels sufficiently to enable the flange to pass over the top of the main rail into the siding instead of passing through a slit in the rail as is the case with our points and crossings. Wharton Switch. Plan of working.

I saw this arrangement in practical working on railways, and it gives great satisfaction. The rails were somewhat narrower on the top table than ours, and the tread of the wheels somewhat broader. The success of this form of switch depends on the outer portion of the tread of the wheel obtaining a good footing on the outer switch rail. Result.

In connexion with permanent way, I should mention that there were exhibited several "car replacers" for restoring cars to the rails after accidents Car Replacers

from trains leaving the rails. This would seem to be an index of the frequency of such accidents.

American signalling arrangements not perfected.

The signalling arrangements on the American Railways have not attained to the perfection to which they have been brought on our railway system, and consequently the only signalling exhibits of notable value were those of the English exhibitors, viz., Messrs. Saxby & Farmer, and Messrs. Brierley, Sons, & Reynolds, both of which are in use in this country and need no description here. There were three or four American exhibits of level-crossing gates, but none of special merit.

Rolling Stock.

Pattern of American Cars.

The exhibits of appliances suited for rolling stock were numerous, and some were of much merit. The pattern of the cars on American railways is essentially different from English cars, but it is sufficiently well known to render further reference to it unnecessary here. The long distances to be travelled on American lines have tended to convert the car into a travelling hotel, and the completeness of the accommodation afforded for this purpose was well exemplified in the exhibits of the Pullman Car Company. It is unnecessary to give a detailed description of these cars here, as their general construction is well known in this country, where, however, the shorter distances travelled over render these cars comparatively unnecessary. They could, however, be very advantageously applied to the journey between London and the North of Scotland, and cars on this principle would be peculiarly advantageous for through trains on the continent, such as those travelling from Calais, Brussels, and Paris to Berlin, Vienna, Florence, Rome, Brindisi, and even to Marseilles, and the Riviera.

Adoption of Pullman Cars on long through routes.

The exhibits of appliances for cars fall under the heads of car fittings; stoves; couplings; springs; car wheels. In connexion with these must be mentioned tyres and axles, (which however apply equally to locomotive engines,) and brakes.

Couplings.

Passenger Cars.

Freight Cars.

Couplings.—The exhibits of Couplings were numerous. In those for the passenger cars there was nothing to supersede the usual coupling now adopted in the United States, termed the Miller platform and coupling, which consists of a compression buffer and coupling; it is self coupling when the cars are run against each other, and holds the platforms in position close to each other. In passenger cars, however, the train servants stand on the platform between the cars and with full access to the coupling, and thus need incur no risk of being injured in the act of coupling. With the freight cars it is different. In these the space between the cars is frequently so restricted that as the coupling is in the centre risk must be incurred by the train servants. Several exhibits were devised to meet this, chiefly by lever movements, with handles to be worked from the side of the car, so as to avoid the necessity of passing between the cars; but in no instance was the invention of such merit as to obtain an award.

Car Fittings; Messrs. Post; Messrs. Cremer.

Car Fittings.—Of the Car Fittings those exhibited by Messrs. Post & Co., of Cincinnati, were deserving of much commendation for their high finish and excellence of workmanship. Messrs. Cremer's exhibits in this line also deserve commendation.

Ticket punching machine for Conductors.

In connexion with car fittings should be mentioned the ingenious apparatus furnished to the conductors of tram cars especially, for punching tickets, with a bell to strike each time it is used, the passenger being requested, by placards in the car, to notice that the bell is struck when his ticket is taken and punched. The number of contrivances in use (more frequently in street cars than in railways) for checking the receipts of the conductors is also remarkable.

These inventions are an index of the difficulties incurred by the transportation companies in obtaining an accurate account of their receipts. This is no doubt incidental to the system of allowing the conductors to issue as well as to collect the tickets, a system which is a necessity on many American railways, because the traffic of many of the smaller stations would not justify the maintenance of a staff of officials; consequently the smaller stations are mainly places to take up and set down passengers or freight; the terminal work not performed by sender or receiver being done by the servants of the company in the train.

Messrs. Cobb and Elliptic Car Spring Company. Spring Cushions.

Amongst other car fittings I would mention a very simple spring cushion, the spring being a ribbon of steel bent into an elliptical form and fixed to the wooden frame on each side at the end of the longer axis of the ellipse. These were exhibited by Messrs. Z. Cobb & Sons, of Wilmington, Delaware, and by the Elliptic Car Spring Company, Cincinnati.

Car Heaters.

Car heaters.—There were several methods of warming cars exhibited. Of course the arrangements for heating applicable to the large saloon cars are different from what our separate carriages require. There were, however, some by means of lamps placed under the car, which might be applied to either arrangement of carriage. But the carrying of fire in any form in a train must always be more or less a source of danger in case of collisions or of cars leaving the rails. The form of Heater which appears to have obtained the greatest favour in America is what is termed the Baker Heater, of which the following is the description: the heat is applied to the car by means of hot-water pipes led round the car on the floor level, with bends to carry the pipes horizontally under each row of seats; the water is heated by coiling a portion of the pipe and passing this coiled portion through a circular iron stove; the fire-box of this stove is of strong wrought iron, and is provided with a grated lid with a latch to be opened for feeding the fire, but which cannot become opened by any violence or by an upset; this fire-box is moreover contained in a second strong covering of wrought iron which terminates in the chimney. No instance is recorded of fire having occurred in train accidents where these stoves have been used. **Baker Heater.**

System of working.

For the circulation, both ends of the pipe terminate in a close cylindrical cistern, placed on the roof of the car, to which the water is supplied by means of a funnel pipe which also acts as a gauge of the level of the water. A safety valve, weighted to 150 lbs. pressure, and an indicator dial, are provided. The safety valve is formed of a compressible india-rubber ball, because a metal seated valve is inapplicable owing to the crystals of salt which form after "blowing off," which prevent the valve from shutting tightly. The india-rubber ball overcomes this difficulty. The liquid used is a saturated solution of salt water, and on first filling great care must be taken by repeated applications of heat to expel all the air. This solution does not freeze at any ordinary low temperatures.

Proportion of heating surface to each Passenger.

The average allowance of heating surface for an ordinary passenger car is stated to be four feet of 1¼ pipe per passenger. A larger amount is required for cars divided into private compartments as is the case in some of the Pullman cars; and the distribution of the pipe varies according to the position of the seats, a smaller amount of surface being allotted to the seats over the flow pipe where it leaves the stove, and a larger amount to those over the colder parts of the return pipe.

Springs.

Springs.—There were several exhibits of springs. It seems that the ordinary caoutchouc springs are not liked in America, either because of the difficulty of obtaining good material or that these springs become hard and useless in severe frosts. Steel springs are, therefore, resorted to.

Varieties.

The forms which are most noticeable from their novelty are the various forms of Volute and spiral springs combined in sets, in some cases partly of steel and partly of india-rubber, and also frequently in nests of four or five. The following are the particulars of weights and durability given by some of the exhibitors.

Vose & Dinsmore.

Vose, Dinsmore, & Co., of New York, exhibited one set nest spiral springs—

Diameter.	Height.	No. of coils.	Sustain.
5½ ins.	6 ins.	3	32,000 lbs. with motion in reserve.
8 „	8 „	5	40,000 „ „

Forty individual rubber-centre springs, each in a steel spiral spring, (2 in. × 5½ in.) cased in groups of 10 each sustain 60,000 lbs., for these they claim great endurance and they guarantee a durability of from five to eight years.

Nichols, Pickering, & Co.

Nichols, Pickering, and Co., of Philadelphia, exhibited elliptic, spiral, and volute springs of American cast steel and of varying capacity, guaranteed for one year. The elliptic having a sustaining power of from 11,000 to 16,000 lbs.; the spiral of from 4,600 to 5,000 lbs. each.

Columbia Spring Company.

The Columbia Spring Company showed group springs of four groups to each car, to carry up to 16 tons for freight cars. Also nest springs with three

spirals in each nest, taking eight springs to the car; also nest springs for buffers with 12,000 lbs. capacity. They use crucible steel, chrome steel, and carbon steel from the Adirondac Steel Manufactory. They guarantee for five years, the market rate being 5d. per lb.

Culmer Spring Company.

The Culmer Spring Company, Pittsburg, Pa., use the best grade American steel, and guarantee against faults of manufacture. Messrs. N. & A. Middleton and Company of Philadelphia use Bessemer steel, and replace failures within seven years.

French & Co.

Messrs. A. French & Co., Pittsburg, Pa., are large makers of elliptic springs of the best cast spring steel only. Their work is of a very high class. They guarantee for five years against breakage in regular service.

The following shows the sizes of the principal springs made by them :—

Description of Car.	Length.	No. of Plates.	Width and thickness of Plates.	Overall.	Capacity of Spring or Bundle.	Weight of Bundle.
	Inches.	No.	Inches.	Inches.		lbs.
Freight - -	20	5	$3\frac{1}{2} \times \frac{11}{32}$	$7\frac{3}{4}$	12,000	108
„ - -	22	6	$3 \times \frac{11}{32}$	$\left\{ \begin{matrix} 9 \text{ or} \\ 8\frac{1}{2} \end{matrix} \right\}$	12,000	$\left\{ \begin{matrix} 136 \\ 120 \end{matrix} \right.$
Passenger - -	30	6	$3\frac{1}{2} \times \frac{11}{32}$	7	5,000	42
„ - -	36	5	$3 \times \frac{11}{32}$	$11\frac{3}{4}$	8,500	282
„ - -	40	6	$3 \times \frac{11}{32}$	$14\frac{1}{2}$	10,000	292
„ - -	36	6	$3 \times \frac{3}{8}$	13	12,000	290
Engine wheels:						
Driver - -	36	10	$3 \times \frac{11}{32}$	$5\frac{1}{2}$	9,000	$84\frac{1}{2}$
Truck - -	36	13	$4 \times \frac{11}{32}$	6	13,000	$133\frac{1}{2}$
Tender - -	52	17	$4 \times \frac{11}{32}$	9	12,000	230

Car Wheels.

Car wheels.—Cast-iron chilled car wheels are in general use in the United States, and the exhibit of car wheels was especially prominent. There were about 30 exhibitors, including foreign exhibitors. I will briefly describe the cast-iron wheels, and then notice such of the exhibits of other forms as appeared to possess merit.

The first chilled wheels were made in 1832, but they were made with flat spokes and the central part was cast with openings to prevent the fracture of that part by shrinking. The first plate wheel which had any success was made by Mr. Lobdell in 1838. The wheel was cast in one piece, the plates or discs were convex on the outside. In 1848 an annealing process was patented by Messrs. Whitney, and has been generally adopted since.

Principal Exhibitors.

The principal exhibitors in the United States were the Lobdell Car Wheel Co., Wilmington, Del., Messrs. Whitney and Sons, Philadelphia, the Hamilton Steeled Wheel Co., Philadelphia, the Taylor Iron Works, High Bridge, N.J., the Cayuta Wheel Foundry Co., Waverley, N.Y., the Ramapo Wheel and Foundry Co., the Pennsylvania Railway, and Mr. W. G. Hamilton, of the Hamilton Steeled Wheel Co., Philadelphia, who exhibited wheels made by his mixture of irons. There were several Canadian exhibits of wheels, notably Messrs. Macdougal and Co., Montreal, and the Toronto Wheel Foundry.

Materials for making cast-iron wheels.

The following is a brief description of the peculiarities of cast-iron wheel making. The material used is a proportion of cold blast charcoal iron, generally of the Salisbury ores, and some warm blast (*i.e.* made with a blast of about 500°) principally from Baltimore ores, a limited quantity of selected old wheels are added in proportion to the quality of the iron.

This is melted in a cupola furnace, and run into pigs which are inspected and sorted for remelting. The remelted iron is run into the chilled moulds, and as soon as the iron has solidified the wheels are removed and placed in an annealing pit, where they are left to cool for three or four days, the object being, by means of the iron chill which forms the rim of the mould, to produce a perfect chill of the outer surface of the tread of the wheel and of the flange; and by means of the annealing process to allow the strains, which the chilled surface causes in the metal, to adjust themselves in cooling.

Mr. Hamilton's process has been devised to meet what he considers will be soon a great difficulty, viz., the insufficient quantity of the Salisbury iron to meet the large demand for wheels, coupled with the probably diminished production of charcoal iron from the great destruction of forests which is taking place all over the country. The following short statement will explain this:— *Mr. Hamilton's Process.*

The production of car wheels in 1876 was about 500,000 wheels, representing a daily requirement of 1,250 tons of iron, of which 300 tons would be obtained from remelting old car wheels and 950 tons from new iron, or a total yearly required of, say 290,000 tons.

The total yield of charcoal iron in 1873 was 574,720 tons as follows:— *Yield of Charcoal Iron.*

	Tons.		Tons.
Maine	780	Alabama	22,283
Vermont	3,100	Texas	280
Massachusetts	15,704	West Virginia	1,950
Connecticut	26,977	Kentucky	42,219
New York	29,327	Tennessee	34,532
Pennsylvania	45,854	Ohio	100,498
Maryland	30,318	Michigan	113,475
Virginia	20,075	Wisconsin	38,880
N. Carolina	1,432	Missouri	39,536
Georgia	7,591		

Of the above the yield of Salisbury iron, calling by that name all made in Massachusetts, Connecticut, and part of New York, was— *Yield of Salisbury Iron.*

Massachusetts	15,704
Connecticut	26,977
New York (say)	5,000
	47,681

Thus the Salisbury iron forms only 16% of the new iron required for car wheels, and the whole production of charcoal iron was only double that required for car wheels alone in a year of small production. This led Mr. G. W. Hamilton to consider whether anthracite irons, of which the production of Pennsylvania is considerable, could by any mixture of metals be utilized for car wheels.

Mr. Hamilton discovered that by adding a proportion of steel non-chilling irons, such as low grade charcoal (warm blast) irons, anthracite, coke, and raw coal irons, can be made available for car wheels.

The mixture he adopts is as follows:— *Various irons used by Mr. Hamilton in process.*

Charcoal iron	24%
Hot blast coke iron	7
Anthracite	25
Old wheels and scrap	34
Old steel rails	10
	100

The results he exhibited especially in the factory of Altoona appeared very satisfactory. *Results.*

The duration of car wheels in the United States was given at from 50,000 to 60,000 miles. They can then be turned up and run a further mileage. The wear of the wheels takes place more rapidly when they are not exactly circular, and to meet this the Messrs. Lobdell have taken steps to turn up wheels before sending them out. The price is enhanced, but they guarantee 90,000 miles. The price of ordinary car wheels varies from 2¾ cents to 3½ cents per lb. *Messrs. Lobdell.*

The exhibits from the Dominion of Canada of car wheels were satisfactory; the prices furnished by Harris & Co., of St. John, N.B., were for 30-inch wheel, $12·75; 33-inch wheel, $16. *Harris & Co., St. John, N.B.*

The failure of chilled iron car wheels may occur—

1st. From the chill failing, *e.g.* pieces on the tread or flange shell out or the tread is comby or seamed.

2nd. From wear on rail, such as worn flange, worn flat, worn hollow at flange, worn hollow on tread.

3rd. From being broken, such as the wheel having bursted, or the flange or rim being broken, or the plate being cracked.

4th. From wearing flat from sliding out or from cracks.

It is said that wheels never burst or break in pieces in running.

Foreign Exhibits. The other notable exhibits of wheels were from Sweden, Belgium, France, and Germany, the latter by Herr Krupp of Essen. The chilled cast-iron wheels and axles of Carl Ekman, of Finspang, Sweden, were remarkable for economy of production and excellence. The Sandvikens Iron Works and the Surahammars Bruk Works both exhibited wheels and axles scarcely worn which had run over 200,000 miles. The wheels from the Atéliers de la Dyle were noteworthy, as also those of the Société de la Providence, both in Belgium. The latter wheels are made solid, of wrought iron, by hydraulic pressure. The wheels of Brunon Fréres, Rive-de-Gier (Loire), France, forged by hydraulic pressure, also deserve mention; as also the wheels exhibited by Lucien Arbel, from the same locality.

Sweden.

Belgium.

France.

As an index that the cast-iron wheel is not affording full satisfaction in America, may be taken the fact that there were several exhibits of other forms of wheels, in which elasticity was sought to be introduced, and notably of wheels with steel tyres.

Compressed Paper Wheels. The exhibit of this nature which seemed to possess most merit was that of wheels of compressed paper. The central portion of the wheel is entirely of paper, compressed by hydraulic machinery to the consistence of wood, but without the liability to split, which wood has more or less; the hub and the tyres are of steel. These wheels are run under the Pullman cars, and a wheel was exhibited which had run for eight years under a Pullman car, for a distance of 302,900 miles, the tyre of which showed very small marks of wear. The duration was attributed to the elasticity of the material. The cost of these wheels was stated to be for a 30-inch and a 33-inch wheel \$42, for a 42-inch wheel \$60. Another form of wheel in which durability was sought in elasticity was a form of locomotive driving wheel, to which steel tyres were fixed, with blocks of hickory between the felloe and the tyre, so as just to relieve the tyre from resting on the iron rim. This class of wheel is stated to have been in use some years, and to have given very favourable results.

Cost.

Composite Wheel.

Axles. *Axles.*—There were several axles exhibited which had for their object to allow the wheels in each pair of wheels to revolve independently of each other. Of these there were three which deserve notice. One by S. L. Harrison, of San Francisco, which had run for 8½ months on street cars in that city. In this, each wheel is fixed to a sheath, which extends to the centre of the axle, and which revolves with the wheel to which it is attached upon the axle. The second was by Mr. Anchinloss, manager of the Jackson and Sharp Company. In this case the axle was divided in the middle, and held in place by a sleeve fitted on in the centre about two feet long, in which the parts could revolve separately. In this case each wheel revolves with its own half of the axle. The third is the axle of the Miltimore Car Axle Company, New York. These were applied to one of the trains running in the Centennial grounds, and with a notable diminution of the friction in passing round the very sharp curves on this railway. In the construction of the Miltimore axle, the wheel is mounted on, but not fixed to, a sleeve which revolves round the axle upon which the car rests; the sleeve being kept in place by the axle boxes, which are fixed to the main axle; the wheel can, moreover, revolve round the sleeve, when by reason of a curve or inequality in the road one wheel is required to move with more rapidity than the other.

S. L. Harrison, San Francisco.

Mr. Anchinloss.

Miltimore Axle.

Brakes. *Brakes.*—The brakes on American railways have been perfected to a far greater extent than in this country. This appears to have arisen from the necessity for the rapid stopping of trains, introduced by the less secure condition of fencing on American railways, and the greater prevalence of single lines.

It would seem moreover to be recognised as an axiom on American railways,—

1st. That the engineer shall have complete control over the application of brake power to all the wheels of the train.

2nd. That in case of the accidental fracture of couplings the detached cars shall be at once brought to rest by the action of the brakes attached to them.

The Westinghouse Brake appears to have obtained the confidence of the American railway managers, and it is applied very extensively on American railways. The Westinghouse Air Brake Company, Pittsburg, Pa., in America, have bought the patent of Smith's Vacuum Brake. They state that they apply this latter occasionally as being less expensive, where rapidity of action is not of paramount importance; but for all passenger trains they recommend their own automatic brake.

Westinghouse Air Brake.

Smith's Vacuum Brake.

The difference between the two broadly stated is, that in the Smith's vacuum brake the application of the brake depends upon the vacuum in the pipes. In the Westinghouse automatic brake, the brakes are applied by a diminution of pressure in the pipes.

The Westinghouse Air Brake, now in use upon two-thirds of the railways of the United States, consists of an air pump driven by steam taken from the locomotive boiler, by which air is forced to a pressure of about 80 pounds per square inch into a reservoir fastened under the foot-plate of the engine. From this reservoir a pipe leads to one opening of a three-way cock, while from a second opening the brake-pipe is extended down beneath the tender and the entire length of the train. Under each car, near the centre, a cylinder, fitted with a piston, is firmly bolted, having a connexion from the piston to the ordinary brake lever, and a branch leads from the main brake pipe to one end of this cylinder. The pipes from car to car are joined by flexible tubes, having malleable iron couplings, which are provided with valves. When these couplings are united the valves are forced open, so that there is a free passage from the three-way cock, the entire length of the train, to the last coupling, where the valve not being unseated, prevents the escape of air.

The handle of the three-way cock, before alluded to, is under the immediate control of the engineer, so that by a simple movement of the hand, he can bring the pipe from the reservoir in communication with the brake-pipe, whereby air is forced through the pipe and into each of the brake cylinders, setting the brakes almost instantly, with any force desired up to the maximum, which is only limited by the amount of pressure carried into the reservoir.

A return of the handle of the three-way cock to its former position first closes the communication between the brake-pipe and reservoir, and then opens the communication from the brake-pipe to the atmosphere, whereby the air is discharged and the brakes released by strong springs, which force the pistons back.

Westinghouse Automatic Brake.

The Westinghouse Automatic Brake differs from the air brake by having, in addition to the main reservoir on the locomotive, an auxiliary reservoir located upon each car in the train. The branch from the main brake-pipe instead of leading directly to the brake cylinder, leads to one opening of a small triple valve-device, passing through which, it enters this reservoir; through a third opening the pipe leads to the brake cylinders. The construction of this valve-device is such that, if air be turned from the main reservoir into the brake-pipe, the auxiliary reservoir will be charged with the same pressure, while at the same time an opening will be made from the brake cylinder to the atmosphere. After the reservoir has become charged, if the air be discharged from the brake-pipe by the engineer, or otherwise, it will cause this triple valve to shift, so as to close the opening from the auxiliary reservoir to the brake-pipe, and from the brake-cylinder to the atmosphere, at the same time opening a direct passage from the auxiliary reservoirs to the brake-cylinders, applying the brake to the full force of the pressure in the reservoir, less the reduction caused by expansion in a larger space.

Plan of working.

It will be seen by the above description that the brakes are off when the pipe is charged with compressed air, and that the brakes are applied by the reduction of pressure in this pipe. A valve arranged in the brake-pipe on each car, with a cord extending through the inside of the car, enables the conductor or brake-man to discharge the air from the pipe, thus setting the brakes on the entire train. The separation of the train, and consequently of the hose-couplings between the cars, discharges the air and applies all of the brakes.

At both ends of each car a cock is arranged in the pipe, and the cock at the rear of the train is closed to retain the pressure; when the train is separated intentionally, the cocks in the pipe are closed where the separation is to take place before the couplings are disconnected, preventing the application of the

brakes. The force with which the brake is applied is entirely under the control of the engineer, who governs the amount of the reduction of pressure in the brake-pipe. A slight reduction, owing to leakage in the brake-pipe, does not apply the brake, whether the locomotive is connected with the train or not. Both halves of the hose-coupling are alike, which permits of the use of a single line of pipe, and these couplings are so constructed that they are perfectly air-tight when united, but can be separated forcibly, by the breaking of a train, without injury.

Mr. Steele's Brake.

The Westinghouse Company have placed their brake prominently before the English public. Mr. Steele has patented a brake in this country which is on the same principle as the Westinghouse automatic brake, for which he claims a greater simplicity of the parts. This brake was fitted to certain carriages to be experimented on by the Royal Commission on Railway Accidents, but Mr. Steele states that the train was not ready in time to obtain conclusive results. In the absence of more complete information as to Mr. Steele's brake, no opinion can be expressed on the relative merits of the two, except that undoubtedly the Westinghouse brake has been proved to be eminently successful on the American railways.

Henderson's Hydraulic Brake.

Amongst the other brakes exhibited was the Hydraulic Brake of the Henderson Hydraulic Car Brake Company, Philadelphia. This was simple in construction and operation. The power is derived from a small portion of the steam from the boiler, applied through a double acting steam cylinder, to work a small hydraulic press. The water pressure is transferred through pipes to pressure boxes, of which there is one attached to one of the brake beams on each truck. An air cushion is provided above the press piston to prevent striking the head when coming back light. The press receives water from either the tender or from a special tank through a check valve; the feed is self-regulating, any excess of water being returned through a small pipe to the tank. For low temperature a mixture of equal parts of glycerine and water is used, which is safe to 24° of Fahrenheit below zero. The pressure boxes are of cast-iron bolted together, embracing a disc-shaped flexible diaphragm of india-rubber. A ram is fitted to the hollow of the diaphragm, two iron rods connect the end of the ram to the opposite break beam. When pressure is applied, the diaphragm moves out in one direction, and the pressure box in the other, thus bringing the opposite brake beams to press against the wheels.

The connexions between the cars are made by means of flexible hose furnished with hydraulic couplings, which couple and uncouple without waste.

Loughbridge Air Brake.

The Loughbridge Air Brake in use on the Baltimore and Ohio Railroad was not exhibited. The particulars of an experiment made with it showed that a train of 10 cars, weighing with locomotive, 230 tons, travelling at a speed of 42·6 miles per hour on a straight and level grade, was stopped in 16 seconds in a space of 196 yards.

Locomotives.

Swedish Locomotive.

The peculiar feature of this class of exhibits was the exhibit of American Locomotives. The only exhibit of a locomotive which was not of United States manufacture was a locomotive from Sweden, for drawing heavy weights on a narrow gauge, it being adapted for the three-feet gauge.

The following are the more remarkable of the American exhibits of locomotives :—

"John Bull" Engine.

It may be mentioned as a curiosity that the Camden and Amboy Railroad Company exhibited the "John Bull" engine; built by George and Robert Stephenson, of Newcastle-on-Tyne, for the Camden and Amboy Rail and Tramway Company, in the year 1831, and which commenced running in September of that year. The cylinders are 9 in. × 20 in. stroke. The driving wheels 4 ft. 6 ins. diameter, with iron hubs, wooden spokes, and iron felloe, and wrought-iron tires. Its weight is 10 tons. It was in use from 1831 till 1861.

Baldwin Locomotive Works.

Of the exhibitors of the latest style of modern American engines, those most noteworthy were the Baldwin Locomotive Works of Philadelphia, owned by Messrs. Burnham, Parry, and Williams, and managed by their able and enterprising partner Dr. Williams. They exhibited five locomotives. The following table shows the particulars of the exhibit of the Baldwin Locomotive Works, of the Light Locomotive of Porter, Bell, and Company, Pittsburg, Pa., and of the engine of the Dickson Manufacturing Company, Scranton, Pa.

—	Exhibit of Baldwin Locomotive Company.					Porter, Bell, and Company.		Dickson Manufacturing Company.		
	Gauge, 4 ft. 8½ ins. Consolidation Pattern, Freight.	Gauge, 4 ft. 8½ ins. Consolidation Pattern, Freight.	Gauge, 4 ft. 8½ ins. Mogul Pattern, Freight.	Gauge, 4 ft. 8½ ins. American Pattern, Passenger.	Gauge, 4 ft. 8½ ins. American Pattern, Passenger.	Gauge, 3 ft. Passenger, 4-wheels, coupled.	Gauge, 3 ft. Mogul Pattern, Freight, 6-wheels, coupled.	Gauge, 4 ft. 8½ ins., 2-wheels, coupled.	Gauge, 3 ft., 3-wheels, coupled.	Gauge, 3 ft. 3-wheels, coupled.
Cylinders.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.
Diameter	1 8	1 8	1 6	1 5	1 5	0 11	0 11	0 17	0 11	0 9
Stroke of piston	2 0	2 0	2 0	1 10	2 0	0 16	0 16	0 24	0 16	0 12
Length of steam-ports	1 4	1 5½	1 4	1 3	1 4	—	—	1 4	0 9½	0 6
Width of steam-ports	0 1½	0 1½	0 1½	0 1½	0 1½	—	—	0 1½	0 1	0 1 3/16
Width of exhaust-ports	0 2½	0 2½	0 2½	0 2½	0 2½	—	—	0 2½ × 16	0 2 × 16	0 1½ × 6
Travel of valve	0 5¾	0 5	0 5¾	0 5¾	0 5	—	—	0 5½	0 4½	0 3
Outside lap of valves	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	—	—	0 0¾	0 0⅝	0 3⅜
Inside lap of valves	0 0 1/32	0 0 1/32	0 0 1/32	0 0 1/16	None.	—	—	—	—	—
Exhaust nozzles	Variable	Double square.	Double variable.	Single high	Double	—	—	—	—	—
Eccentric	—	—	—	—	—	—	—	0 4½	0 4½	0 3
Wheels.						ins.	ins.			
Diameter of driving wheels	4 2½	4 2	4 6	5 2	5 2	40 to 44	36 to 40	5 7	3 6	2 5
Diameter of truck wheels	2 6	2 4	2 6	2 4	2 4	26 „ 28	24 „ 26	2 6 (spread of truck, 5 ft. 6 ins.)	2 0 (spread of truck, 4 ft. 8 ins.)	—
Distance between centres of front and rear driving wheels.	14 9	13 8	15 0	8 6	8 6	ft. ins. 6 0	ft. ins. 9 0	8 0	6 8	4 6
Total wheel base of locomotive	22 10	21 6	22 8	22 5	22 5½	15 10	14 6	21 10	17 6	4 6
Total wheel base of locomotive and tender	46 2	27 7	44 3	44 2½	44 3½	32 6 (39 feet length over all of engine and tender).	34 0 (41 feet length over all of engine and tender).	33 ft. 8½ ins., length of engine, 53 ft. 8½ ins. length over all of engine and tender.	26 ft. 3 ins. length of engine, 42 ft. 6½ ins. length over all of engine and tender.	17 ft. 10½ ins. length of engine.
Diameter of driving axle journals	0 7	0 6½	0 7	0 7	0 7	—	—	0 7	0 5	0 4½
Length of driving axle journals	0 8	0 7½	0 8	0 8	0 7½	—	—	—	—	—
Diameter of main crank-pin bearing	0 5	0 4½	0 4½	0 4½	0 3¾	—	—	—	—	—
Length of main crank-pin bearing	0 5	0 5	0 4½	0 4½	0 3¾	—	—	—	—	—

	Exhibit of Baldwin Locomotive Company.					Porter, Bell, and Company.		Dickson Manufacturing Company.		
—	Gauge, 4 ft. 8½ ins., Consolidation Pattern, Freight.	Gauge, 4 ft. 8½ ins., Consolidation Pattern, Freight.	Gauge, 4 ft. 8½ ins., Mogul Pattern, Freight.	Gauge, 4 ft. 8½ ins., American Pattern, Passenger.	Gauge, 4 ft. 8½ ins., American Pattern, Passenger.	Gauge, 3 ft., Passenger, 4-wheels, coupled.	Gauge, 3 ft., Mogul Pattern, Freight, 6-wheels, coupled.	Gauge, 4 ft. 8½ ins., 2-wheels, coupled.	Gauge, 3 ft., 3-wheels, coupled.	Gauge, 3 ft., 3-wheels, coupled.
Boiler.	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.			ft. ins. inside	ft. ins. inside	ft ins. inside
Outside diameter of smallest ring of boiler	4 6	4 6½	4 3	4 0	4 1⅜	—	—	4 0	3 0	2 4⅛
Thickness of boiler plates	½ in. (iron)	⅜ in. (steel)	0 0½	⅜ in. (steel)	0 0 5/16	—	—	boiler and tubes iron.	boiler and tubes iron.	boiler and tubes iron.
	No.	No.	No.	No.	No.			No.	No.	No.
Number of tubes	198	138	159	163	155	—	—	163	92	65
	ft. ins.	ft. ins.	ft. ins.	ft. ins.	ft. ins.			ft. ins.	ft. ins.	ft. ins.
Length of tubes	11 0	12 11	11 2¾	11 3	10 8	—	—	11 6	8 8½	7 4¾
Outside diameter of tubes	0 2	0 2¼	0 2	0 2	0 2¼	—	—	0 2	0 1½	0 1½
Length of fire-box inside	9 10	8 0	5 5	8 6	6 0⅝	—	—	8 7	6 0	2 10
Width of fire-box inside	2 9¾	2 10½	2 11½	2 9¾	2 10⅞	—	—	2 9¾	1 8½	1 11¾
Depth of fire-box inside sloping	44½–55 ins.	42–61 ins.	5 3½	39–53 ins.	5 7	—	—	4 1½	2 11½	2 4½
Thickness of fire-box plates, steel sides and back	0 0 5/16	—	(copper) ½ in.	0 0½	—	—	—	Steel	Steel	Steel.
Thickness of flue-sheet	0 0½	0 0½	0 0⅞	0 0½	0 0½	—	—	Grate area, 24·74 sq. ft.	Grate area, 10·25 sq. ft.	Grate area, 5·6 sq. ft.
Thickness of crown sheet	0 0⅜	0 0 5/16	(steel) ⅜ in.	0 0⅝	0 0 5/16	—	—			
Square feet of grate surface	27 6	23 0	16 0	24 0	18 0	—	—			
								sq. ft.	sq. ft.	sq. ft.
Square feet of heating surface in fire-box	149 0	92 0	103 0	112 0	106 0	—	—	118·10	63·74	32·0
Square feet of heating surface in tubes	1,132 0	1,166 0	937 0	953 0	971 0	—	—	974·40	314·50	188·7
Total square feet of heating surface	1,281 0	1,258 0	1,040 0	1,065 0	1,077 0	—	—	1,092·50	378·25	220·7
Weight.										
Weight of engine in working order	100,000 lbs.	91,640 lbs.	80,000 lbs.	75,000 lbs.	71,300 lbs.	33,000 lbs.	35,000 lbs.	71,000 lbs.	39,000 lbs.	18,900 lbs.
Weight of engine on driving wheels	88,000 „	79,400 „	68,000 „	51,500 „	45,800 „	25,000 „*	31,000 „†	47,000 „	26,500 „	18,900 „
Weight of tender	„ „	—	20,000 „	20,500 „	22,000 „	—	—	Capacity of tender tank, 24,000 galls.	Capacity of tender tank, 1,100 galls.	Capacity of tender tank, 260 galls.
Fuel	Anthracite	Coal, Bituminous.	Coal, Bituminous.	Coal, Anthracite.	Coal, Bituminous.	—	—	—	—	—

*	
Weight on 2-wheel radius-bar pony truck	8,000 lbs.
Water capacity of tender tank	1,100 galls.
Weight per yard of rail advised	35 lbs.
Hauling capacity, exclusive of tender, in tons of 2,000 lbs. — on level	640 tons.
— on grade of 40 ft. per mile	195 „
— on grade of 100 ft. per mile	85 „

†	
Weight on 2-wheel radius-bar pony truck	4,000 lbs.
Water capacity of tender tank	1,100 galls.
Weight per yard of rail advised	30 lbs.
Hauling capacity, exclusive of tender, in tons of 2,000 lbs. — on level	800 tons.
— on grade of 40 ft. per mile	255 „
— on grade of 100 ft. per mile	110

The following remarks on these engines will enable an opinion to be formed of the merits of American engines as compared with those in use in England. American Engines.

The consolidation pattern No. 1 has been used on the Lehigh Valley Railroad over maximum grades of 126 feet per mile, with a maximum load of 35 loaded 4-wheel cars, which weigh 329 tons with lading. On a grade of 76 feet per mile, it draws 476 gross tons, including cars. Lehigh Valley Railroad.

The consumption of fuel is given at 3¾ tons daily.

The No. 2 consolidation engine does the following :—

——	No. of Cars.	Total Weight, exclusive of Engine.	Maximum Grade, and Feet per Mile.	
		Tons.		
Philadelphia and Columbia -	35	734	40.	Philadelphia and Columbia.
Columbia and Harrisburg -	70	1,470	Short grade of 80 ft.	Columbia and Harrisburg.
Erie and Langdon's - -	24	504	71.	Erie and Langdon's.
Renovo and Jersey Shore - -	80	1,680	16 ft. for 4 miles.	Renovo and Jersey Shore.

Average consumption of fuel 4·2 lbs per car per mile on Philadelphia and Columbia division; and 2·7 lbs. per car per mile on the Columbia and Harrisburg division.

The passenger locomotive American pattern No. 2 travels between Harrisburgh and Altoona, at 38 miles an hour with a train weighing 171 tons, exclusive of engine, on the maximum grade of 21 feet per mile. The average consumption of fuel being about 37 lbs. per mile. Between Altoona and Pittsburg, with a maximum gradient of 52 feet per mile travelling east, and 95 feet per mile going west, at a speed of 33 miles per hour, these engines convey a train averaging 276 tons, exclusive of engine; the average consumption of fuel being 46 lbs. per mile.

The second division of the table shows the dimensions of Messrs. Porter and Bell, and the Dickson Manufacturing Company's engines for the 3 feet gauge. Of this class, there was also exhibited one not in the table by the Baldwin Locomotive Works, which was running in the Centennial grounds, conveying passengers from one part of the grounds to the other. There were two other engines also running on this railroad, one exhibited by the Mason Machine Works, Taunton, Mass., the other engine exhibited by the Brook's Locomotive Works, Dunkirk, N.Y. Porter and Bell. Dickson Manufacturing Company. Mason Machine Works. Brook's Locomotive Works.

The apprentices of the Philadelphia and Reading Railroad exhibited an engine for the coal traffic of that line. It was a freight engine, 6 driving wheels, 4 feet 6 inches diameter, with a 2-wheeled bogie in front. The fuel is anthracite. The fire-box of steel, 8 feet long by 42 inches wide, and 38 inches deep to crown. The tubes of wrought-iron, lap welded. It was stated that the duration of such a fire-box with anthracite coal was 175,000 miles. The coal traffic is down hill on an easy gradient of 12 feet per mile; the engine brings down a load of 1,060 tons, and takes back 405 tons of cars empty, at a speed for the down journey of 10 to 12 miles, and of 12 to 15 miles for the up journey, with a consumption of fuel, of 70 lbs. per mile for the down trip, and 98 lbs. per mile for the up trip. Philadelphia and Reading Railroad.

The following is a tabular statement of the dimensions of two Centennial engines, one a passenger engine, the other a plantation engine, exhibited by the Danforth Locomotive and Machine Company, Paterson, N.Y., and which also received an award. Danforth Locomotive and Machine Company.

——	No. 1. Cylinders 11 × 16.	No. 2. Cylinders 17 × 24.
Weight:		
Weight on drivers	- - -	45,000
Weight on trucks	- - -	20,000
Total weight of engine	34,000	65,000
„ „ „ empty	27,000	58,000
Weight of tender	- - -	About 20 tons loaded.
Boiler:		
Total length	13 ft. $11\frac{7}{16}$ in.	22 ft. $1\frac{3}{4}$ in.
Inside length of fire-box	4 ft. 6 in.	8 ft. 0 in.
„ width „	17 in.	$34\frac{5}{8}$ in.
„ height „	$39\frac{1}{4}$ in.	42 in. × 54 in.
Length of tubes	7 ft. 0 in.	10 ft. 6 in.
Outside diameter of tubes	$1\frac{3}{4}$ in.	2 in.
Number of tubes	92	175
Diameter of cylinder of boiler	36 in.	46 ft. $\frac{7}{8}$ in. telescopic
Outside length of fire-box	5 ft. $2\frac{1}{16}$ in.	8 ft. $8\frac{3}{8}$ in.
„ width „	$24\frac{3}{8}$ in.	42 in.
Height from crown to top of shell	$12\frac{3}{4}$ in.	$20\frac{1}{2}$ in.
Depth of combustion chamber	None	6 in.
Height of dome	22 in.	26 in.
Diameter of dome	$22\frac{1}{2}$ in.	26 in.
Kind of material in boiler	Penwock's iron.	Penwock's iron.
Thickness of material in boiler	$\frac{3}{8}$ in.	$\frac{3}{8}$ in.
Kind of material in fire-box	Zoy State steel	Park Bros. steel
Thickness „ „	$\frac{5}{16}$ in.	$\frac{5}{16}$ in.
Thickness of flue sheets	$\frac{1}{2}$ in.	$\frac{1}{2}$ in. × $\frac{7}{16}$ in.
Crown bars	10 ft. 4 in. × $\frac{5}{8}$ in. double.	18 double $4\frac{1}{2}$ in. × $\frac{5}{8}$ in.
Heating surface:		
Grate areas	$6\frac{3}{10}$ sq. ft.	$22\frac{3}{4}$ sq. ft.
Fire-boxes	49 sq. ft.	$98\frac{1}{2}$ sq. ft.
Combustion chambers	None	3 sq. ft.
Tubes	295 sq. ft.	962 sp. ft.
Total heating surface	344 sq. ft.	$1{,}063\frac{1}{2}$ sq. ft.
Cylinder heads:		
Diameter	11 in.	17 in.
Stroke	16 in.	24 in.
Size of steam ports	$\frac{3}{4}$ in. × 8 in.	$1\frac{1}{4}$ in. × $15\frac{1}{2}$ in.
„ exhaust ports	$1\frac{1}{2}$ in. × 8 in.	$2\frac{1}{4}$ in. × $15\frac{1}{2}$ in.
Width of bridge	$\frac{3}{4}$ in.	1 in.
Driving wheels and axles:		
Number	6	4
Diameter of centre	32 in.	4 ft. $9\frac{3}{4}$ in.
Distance through stubs	$5\frac{1}{4}$ in.	7 in.
Diameter of wheel fit	$4\frac{3}{8}$ in.	$6\frac{3}{8}$ in. × $6\frac{5}{16}$ in.
Length of journal	6 in.	$7\frac{7}{8}$ in.
Diameter „	$4\frac{1}{2}$ in.	$6\frac{1}{2}$ in.
Diameter of body of axle	$4\frac{1}{4}$ in.	$6\frac{1}{4}$ in.
Width of tyres	$4\frac{3}{4}$ in. × $5\frac{1}{4}$ in.	$5\frac{3}{4}$ in.
Inside diameter of tyres	$31\frac{15}{16}$ in. full	4 ft. $9\frac{8}{16}$ in.
Thickness of tyre	$2\frac{1}{2}$ in.	$2\frac{1}{2}$ in.
Make of tyre	standards	standards
Number of arms	10	16
Cranks, pins:		
Diameter of main pin journal	$2\frac{1}{2}$ in.	4 in.
Length „ „	3 in.	$3\frac{3}{4}$ in.
Thickness of collar, main pin	$1\frac{1}{8}$ in. × $\frac{1}{2}$ in.	$\frac{5}{8}$ in. counterbore, $\frac{5}{16}$ in.
Diameter „ „	4 in. × $3\frac{3}{8}$ in.	$5\frac{1}{2}$ in.
Diameter of back pin journal	$2\frac{1}{4}$ in.	3 in.
Length „ „	2 in.	3 in.
Thickness of collar, back pin	$\frac{1}{2}$ in.	$\frac{5}{8}$ in. counterbore, $\frac{5}{16}$ in.
Diameter of „ „	4 in. × 3 in.	$5\frac{1}{2}$.

—	No. 1. Cylinders 11 × 16.	No. 2. Cylinders 17 × 24.
Engine frame:		
Size, front end	2 in. × 3 in.	$3\frac{1}{4}$ in. × 4 in.
„ back end	2 in. × 3 in.	$2\frac{1}{4}$ in. × 4 in.
„ top pedestal	$2\frac{1}{4}$ in. × 3 in.	$3\frac{1}{4}$ in. × 4 in.
„ pedestal leg top	$2\frac{1}{4}$ in. × 3 in.	3 in. × 4 in.
„ „ bottom	$1\frac{1}{2}$ in. × 3 in.	$1\frac{3}{4}$ in. × 4 in.
Distance apart, pedestal leg bottom	$9\frac{1}{4}$ in.	13 in.
„ „ „ top	$7\frac{3}{4}$ in.	$9\frac{1}{2}$ in.
Length, pedestal, inside	$12\frac{1}{2}$ in.	18 in.
Size, back end, top	2 in. × 3 in.	$2\frac{1}{2}$ in. × 4 in.
Connecting rods:		
Length of main rod	4 ft. 1 in.	6 ft. $3\frac{1}{8}$ in.
Width of back stub	3 in.	$4\frac{3}{4}$ in.
Length „	$4\frac{1}{8}$ in.	$8\frac{5}{16}$ in.
Thickness „	$2\frac{1}{4}$ in.	$2\frac{1}{2}$ in.
Width „ neck	$2\frac{3}{4}$ in.	$4\frac{1}{16}$ in.
Thickness „	$1\frac{5}{8}$ in.	$1\frac{7}{8}$ in.
Length of back parallel rod	5 ft. $10\frac{7}{8}$ in.	7 ft. 7 in.
Width of back stub	$2\frac{3}{4}$ in.	$3\frac{3}{4}$ in.
Thickness „	$1\frac{1}{2}$ in.	$2\frac{1}{4}$ in.
Length „	$5\frac{3}{4}$ in.	8 in.
Width „ neck	$2\frac{1}{2}$ in.	$3\frac{1}{2}$ in.
Thickness „ „	$1\frac{5}{16}$ in.	$1\frac{13}{16}$ in.
Engine truck wheels and axles:		
Number of wheels	- - -	4
Diameter	- - -	28 in.
Between stubs	- - -	4 ft. $3\frac{7}{8}$ in.
Through „	- - -	7 in.
Length of journal	- - -	7 in.
Diameter „	- - -	$4\frac{1}{2}$ in.
Diameter of body of axle	- - -	4 in.
Diameter of wheel fit	- - -	straight $4\frac{3}{8}$ in.
Whose make of wheels	- - -	Ramapo
„ „ axle	- - -	Danforth Locomotive and Machine Company.
Steam chest and valve:		
Length of steam chest	12 in.	$19\frac{3}{4}$ in.
Width „ „	$11\frac{1}{8}$ in.	20 in.
Height „ „	$4\frac{5}{16}$ in.	6 in.
Length of valve	$5\frac{1}{4}$ in.	$8\frac{1}{4}$ in.
Width „	$9\frac{1}{2}$ in.	$17\frac{1}{2}$ in.
Size of cavity	3 in.	$4\frac{1}{8}$ in. × $15\frac{1}{2}$ in.
Lap of valve	$\frac{3}{8}$ in.	$\frac{3}{4}$ in.
Inside cup of valve	None	$\frac{1}{16}$ in.
Load of valve	scant $\frac{1}{16}$ in.	scant $\frac{1}{16}$ in.
Travel of valve	3 in.	$4\frac{7}{8}$ in.
House:		
Height of house	6 ft. 4 in.	5 ft. 7 in.
Length „	7 ft. 0 in.	5 ft. $0\frac{1}{2}$ in.
Width „	6 ft. 8 in.	7 ft. $7\frac{1}{4}$ in.
Kind of wood	speck iron	black walnut.
Engine-truck frames:		
Size of iron in frame	- - -	$1\frac{1}{2}$ in. × 4 in.
Wrought or cast pedestal	- - -	wrought
Width of pedestal inside	- - -	7 in.
Length „ „	- - -	$12\frac{1}{4}$ in
Length inside of pedestal	- - -	- - -
Centre bearing or swing	- - -	centre bearing.
Height of centre fume frame	- - -	- - -
Distance apart of wheels	- - -	5 ft. 9 in.

—	No. 1. Cylinders 11 × 16.	No. 2. Cylinders 17 × 24.
Slides:		
Length of slides	3 ft. $0\frac{1}{2}$ in.	50 in.
Maker and kind of slides	Danforth Locomotive and Machine Company, steel.	Danforth Locomotive and Machine Company, steel.
Width and thickness	2 in. × $2\frac{1}{8}$ in.	$1\frac{5}{16}$ in. $1\frac{3}{4}$ in. × $2\frac{7}{8}$ in.
Oval plate	1 in. thick	$\frac{7}{8}$ in.
Cross-heads:		
Kind of cross-head	wrought iron	cast iron
Kind of gibs	cast iron	iron
Solid or loose pin	Loose	solid
Length of wing	9 in.	$15\frac{7}{8}$ in.
Centre of pin below centre of slide	3 in.	$7\frac{3}{8}$ in.
Feed water:		
Brass or iron pump barrel	brass	brass
„ top chamber	„	„
„ bottom chamber	„	„
One or two pumps	1	1
Diameter of plunger	$1\frac{5}{16}$ in.	$2\frac{1}{8}$ × $32\frac{1}{4}$ in.
Kind of ingress pipe	$1\frac{1}{2}$ in., copper	$2\frac{1}{4}$ in., copper
„ feed cock	iron	$2\frac{1}{4}$ in., ordinary
Injector, size and kind	1 No. 5 little giant	1 No. 8, Mack's
„ steam valve	furnished with injector.	furnished with injector.
Piston:		
Piston packing, kind	cast iron, steam	brass
Piston rod, diameter of kind	$1\frac{3}{4}$ in.	$2\frac{5}{8}$ in.
Rocker box:		
Diameter of rocker	2 in.	$3\frac{1}{4}$ in.
Length between arms	11 in.	$11\frac{1}{2}$ in.
Lengths of arms (centre)	$7\frac{3}{8}$ in.	9 in.
Eccentrics:		
Diameter of eccentrics	$11\frac{1}{2}$ in.	14 in.
Width „	$1\frac{7}{8}$ in.	$2\frac{3}{4}$ in.
Throw „	$3\frac{1}{2}$ in.	$5\frac{1}{2}$ in.
Boiler braces:		
No. of boiler braces	- - -	4
Where placed	- - -	1 edge in front course finished.
How finished	- - -	1 edge in back course finished.
Screwed or riveted	- - -	screwed
Lifting shaft and reverse lever:		
Height of lifting shaft from frame	1 in.	$8\frac{5}{8}$ in.
Length of lower arm	13 in.	18 in.
Length of upper „	18 in.	„
Diameter of shaft	$1\frac{3}{4}$ in.	3 in.
Diameter of journal	$1\frac{1}{2}$ in.	2 in.
Distance between lower arms	17 in. centre	$32\frac{1}{8}$ in.
Reverse lever	small size	ordinary straight
Link work:		
Length of link inside	$12\frac{1}{4}$ in.	$19\frac{1}{2}$ in.
Centre of link to centre of saddle	$\frac{11}{32}$ in. back	$\frac{5}{16}$ in. back
Open or solid link	solid	solid
Length of block	3 × $3\frac{1}{4}$ in.	6 in.
Length of block flanges	4 × $4\frac{1}{4}$ in.	8 in.
Radius of link	2 ft. 4 in.	4 ft.
Length of hanger	$8\frac{1}{2}$ in.	13 in.
Expansion braces:		
Number expan. braces, top	1 ft. 8. in. long	1 ft. 16 in. long
„ „ bottom	none	none

	No. 1 Cylinders 11 × 16.	No. 2 Cylinders 17 × 24.
Expansion braces—*cont.*		
Size	8 × $3\frac{1}{4}$ in.	$16\frac{1}{2}$ × $3\frac{1}{2}$ in.
No. of staples	2 ft. 6 in. long each side.	1 ft. 8 in. × 1 ft. 10 in. wide.
Springs:		
Size driving springs	24 in. long	37 in. long
No. leaves	8 in. front, 7 in. back main.	12 ft. 2 in. long wires.
Size steel	3 × $\frac{3}{8}$ in.	3 × $\frac{3}{8}$ in.
Weight each will carry	$1\frac{1}{4}$ in. draw 9,000 & 10,000 lb.	$2\frac{5}{8}$ in. draw 10,000 lb.
Size engine truck springs	- - -	$34\frac{1}{2}$ in. long
No. leaves	- - -	14
Size of steel	- - -	$3\frac{1}{2}$ × $\frac{3}{8}$ in.
Weight each will carry	- - -	$1\frac{1}{4}$ in. draw 10,000 lb.
Size tender truck springs	- - -	29 in. long.
No. leaves	- - -	11 front, 12 back
Size of steel	- - -	4 in. × $\frac{3}{8}$ in.
Weight each will carry	- - -	11 plate 1 in., draw 7,000, 12 plate 1 in. and 8,000.
Grate:		
Grate	wrought iron, $2\frac{1}{2}$ × $\frac{1}{2}$ in., placed $\frac{1}{2}$ in. apart with drop in front.	water grate, 11 tubes $1\frac{1}{2}$ in.
Grate-work	cast-iron bearing bar.	gas pipe, 3 in. centre, 4 loose bars.
Tank and Tender frame:		
Capacity, one each of engine	300 gallons each	2,200 gallons
Length	- - -	17 ft. 6 in.
Depth of back	- - -	6 ft. 6 in. × 4 ft. 6 in.
Height	- - -	3 ft. 6 in.
Length of leg	- - -	18 × 11 in.
Width "	- - -	24 in.
Size of coal space	- - -	156 cubic ft.
Length of frame	- - -	20 ft. $2\frac{1}{2}$ in.
Width of frame	- - -	7 ft. 6 in.
Miscellaneous:		
Kind of steam gauge	brass, $8\frac{1}{2}$ in. back	$8\frac{1}{2}$ in. back, brass
Water gauge	none	none
Furnace door	cast-iron on hinges	on hinges
Safety valve	1 ordinary, 1 Lynde lock.	1 ordinary
Spring balance	Ayers	1 Ayer
Kind pop valve	Lynde	1 Lynde
Size of whistle	4 in. bell made by Danforth company.	6 in. bell
Kind sand box	slides, valve, small	iron body, cast-iron frame.
Kind of bell	small	brass
Ash pan	fits inside of ring	3 sliding doors on bottom.
Blower pipe inside of lagging	heater cock, $\frac{1}{4}$ in. pipe.	ordinary $\frac{1}{2}$ in. pipes
bumper	8 × 10 in., wood	7 × 12 in., wood
Branch pipe	4 in. cast iron	6 in.
Throttle lever	small size	ordinary
Throttle	5 in. balance	5 in. balance
Throttle stuff box	small	ordinary
Main steam pipe	4 in. wrought iron	5 in.
Foot plate	sheet iron	cast iron

—	No. 1 Cylinders 11 × 16.	No. 2 Cylinders 17 × 24.
Miscellaneous—*cont.*		
Gauge cocks - - - - -	ordinary, made short.	4 ordinary
Healer cocks - - -	small size	1 "
Oil pipe - - - - - -	$\frac{1}{4}$ in. pipe	$\frac{1}{4}$ in. pipe under lagging.
Steam chest oil cups - -	Made by Danforth Locomotive Machine Company, 2 in house, 2 in steam chest.	2 in house, and 2 in steam chest.
Rocker oil cups - - - - -	Made by Danforth Locomotive Machine Company.	2 Dryfus.
Slide oil cups - - -	" "	4 "
Connecting rod oil cups - -	" "	6 "
Pilot - - - - -	none	wood
Running board - - - - -	ash	brass on edge
Smoke box door - - -	cast iron	cast-iron
Spring saddles - - - - -	wrought iron	"
Tender truck frame :		
Size of iron in frames - -	- - -	$3\frac{1}{2} \times 1\frac{1}{2}$ in.
Cast or wrought pedestals - -	- - -	cast
Width of pedestal inside - -	- - -	$4\frac{5}{8} \times 6\frac{1}{8}$ in.
Length of pedestal inside - -	- - -	$11\frac{1}{2}$ in.
Thickness pedestal - -	- - -	$4\frac{5}{8}$ in.
Height of centre from frame -	- - -	—
Distance apart of wheels - -	- - -	46 in.
Tender wheels and axles:		
Number of wheels - - -	- - -	8
Diameter " - - -	- - -	30 in.
Between stubs - - - - -	- - -	4 ft. $1\frac{1}{2}$ in.
Through " - - -	- - -	7 in.
From face of stub to rim - -	- - -	$1\frac{11}{16}$ in.
Whole length of axle -	- - -	6 ft. 8 in.
Length of journal - - -	- - -	6 in.
Diameter of journal - -	- - -	$3\frac{7}{8}$ in.
Distance between journals - -	- - -	6 ft. $\frac{5}{8}$ in.
Diameter of wheel fit - -	- - -	$4\frac{5}{8}$ in.
Diameter of body of axle - -	- - -	4
Whose make of axle - -	- - -	Danforth Locomotive and Machine Company.
Whose make of wheel - - -	- - -	Ramapo

Rogers Locomotive and Machine Works.

The Rogers Locomotive and Machine Works, Paterson, N. J., also obtained an award.

One important feature of the American locomotives appears to be the system of supporting the front part of the engine at a point as forward as possible, *e.g.*, under the centre of the smoke-box. The cylinders are horizontal, cast in one piece with the half-saddle; the two halves of the saddle are firmly bolted together and form the support for the smoke-box; under the centre of the smoke-box is the pivot which rests on a swinging bolster suspended from the bogie truck. The centre of the smoke-box is thus over the centre of the bogie truck, and the leading wheels of the truck are well forward in advance of the weight. The ordinary bogie, or 4-wheel truck, some freight engines, and some recent forms of passenger engine, dispense with the 4-wheeled bogie truck, the front part of the locomotive being carried on a pair of wheels, which are termed a pony truck. These wheels are placed as much in front of the body of the engine as the leading wheels of the bogie truck would be

placed, and have a radial motion from about four feet back from the centre of the truck, the weight being equalized with the leading drivers.

The use of the bogie or of the pony truck to support the front part of the engine ensures as short a rigid wheel base as possible. The passenger engines have invariably four coupled wheels as driving wheels; the plan of limiting the rigid wheel base to the driving wheels, and of placing the front supporting wheels of the engine well in advance, gives very great steadiness of motion to the engines. A special train I travelled in on the Fort Wayne and Chicago Railroad ran 50 miles in 51 minutes, including three stoppages at level crossings of railways, on a practically level grade; the engine and train were remarkably steady. **Fort Wayne and Chicago Railroad.**

There are many points of detail about the engines which deserve notice. For instance, the fire-boxes are of steel; the tubes of iron (generally charcoal iron); the boiler is generally of steel. Anthracite coal is used largely in the State of Pennsylvania near the anthracite coal fields. The tabular statement of the Exhibit of the Baldwin Locomotive Company shows the relative sizes of fire-boxes for each sort of locomotive. The injector is in use on almost all engines, but the confidence in the injector has not prevented pumps from being generally retained in addition. **Baldwin Locomotive Company.**

A peculiar feature of the American locomotive is the head light. These seem to have originated with the necessity for showing a strong light from the engine in approaching level crossings, which were formerly entirely unfenced, or in passing along the streets of towns, where the railroad runs along the streets much as tramways do in this country. The head-light is a lamp about 20 to 24 inches square or in diameter. The light is placed in the centre of a highly polished parabolic reflector, and the oil used is of the best description, indeed shops advertising the best oil for domestic use advertise it as head-light oil. **Head Light.**

Performances of Engines.

In connexion with these exhibits of locomotive engines, it is interesting to make some mention of the working arrangements on one of the portions of the Pennsylvania Railway, which I had the opportunity of observing. **Pennsylvania Railway.**

The principle of competition for securing economy of working is put in force as far as possible. The manager of the company informed me that they find it preferable to keep the several portions of the line distinct in regard to workshops, both for manufacture and repairs, and limited in respect to size to what one superintendent can so look after as to know what work every man is doing. The idea being that thus a comparison can be instituted between the cost and quality of the work at the several shops. **Working Arrangements.** **Workshops.**

Similarly with the working of the engines. A strict comparison of the cost of running is kept, and published among the men, and a system of premiums is also adopted. The engineer (or what we term engine-driver) on American railways is a person generally of superior education to those on our railways. The engine itself is fitted up with great comfort in regard to seats and protection from the weather. There are guilds or associations to which the engineers belong. **Engines.**

A system of premiums is of course subject to the difficulty that the engineer may occasionally supplement his supply of coal for the cars by taking coal from the trains or from shunting engines. It was stated that this was not found to be a practical inconvenience, as the number of premiums is sufficient to induce each to watch the others closely in that respect; and only one case of such an occurrence was known. **Premiums**

There are monthly first-class premiums of $20 = 4*l*. to the engineer, and $10 = 2*l*. to the fireman; and second-class premiums of $15 = 3*l*. to the engineer, and $7·50 = 1*l*. 10*s*. to the fireman; and annual first-class premiums of $100 = 20*l*. to the engineer, and $50 = 10*l*. to the fireman; and second-class premiums of $75 = 15*l*. to the engineer, and $37·50 = 7*l*. 10*s*. to the fireman. **Scales of Premium, Monthly. Annual.**

The premium on passenger engines is based on the lowest cost per car hauled one mile; and for freight engines, the lowest cost per loaded car hauled one mile. The results for premiums are taken from the monthly and annual printed reports of the performances of engines. A mileage of 1,500 miles must

be made in the month to entitle to monthly premium, and 18,000 miles in the year to entitle to the annual premium. The time kept is not directly brought into account in the table in awarding premiums, but it was stated that conduct generally was considered. In calculating the mileage of freight cars, five empty cars are counted as three loaded cars.

The table opposite shows the method in which the performance and cost of the engines is published.

Cost of Engine Power.

The cost of engine power on some sections of this railroad and on the Illinois railroad, also a coal-burning line, contrast as follows:—

——	Erie and Pittsburgh.	Pittsburgh and Cleveland, 1875.	Pittsburgh, Fort Wayne, Chicago, 1875.	Illinois Railroad, 1874.
	$ cents	$ cents	$ cents	$ cents
Total cost of engine power per mile run, including repairs, &c.	18 00	17 91	17 72	19 57
	miles	miles	miles	miles
Miles run to a ton of coal.	37 84	53 17	44 00	35 10
Miles run to a quart of oil.	38 93	38 28	34 21	31 00

Fast Freight System.

Empire Transportation Company.

The exhibit by the Empire Transportation Company of the American Fast Freight system closes the list of exhibits to which I propose to draw attention.

No Clearing House System in United States.

The United States railways have no system for the interchange of traffic such as has grown up under the Railway Clearing House. The evils which arose from this were enormous. Each road, if but 50 miles long, had its own traffic, its own classification of property, its own time tables, and charged its own rates without regard to through contracts made by other roads. No efforts were made to forward through goods with speed. Bankruptcy of roads were not unfrequent, a solvent company forming the link in a through route would detain the goods for prepayment of accumulated freight charges from its insolvent neighbour. Such delays led to great damage to property, but if goods were damaged or delayed on the road the delivering company would refer the owner to seek his remedy as best he could from the intermediate roads. In Great Britain these difficulties were never experienced in an aggravated form owing to the earlier railways having allowed the through merchandise to be carried by Pickford, Chaplin and Horne, and other great carriers already possessed of the carrying trade of the country. To meet the public wants of the United States in this respect several transportation companies have been formed, and the exhibit of the Empire Transportation Company was intended to exemplify this system, which has an extension beyond the railway system.

Empire Transportation Company: Date of commencing operations.

The Empire company commenced its operations in 1865; its object was to increase convenience, promptness, and safety in the transfer of property between inland points west of the Philadelphia and Erie Railway and points on the Atlantic slope and seaboard, and with foreign countries eastward. The route consisted at that time of ten independent railways, whose discordant interests prevented unity of action.

The Empire Transportation Company, formed of persons of railway experience and connexions, became agents of these several companies. It became responsible to the parties forwarding goods for rates and prompt delivery. It should here be observed that various other methods have been made to meet the difficulties abo e described. One was for the railway companies to co-operate with each other under a specific name, such as the "Purple Line," "Orange Line," "Planet Line." A board of management would be formed consisting of

Opposition Schemes.

Ballast and Repairs.	Total Expense of Engines.	Average Cost per Loaded Car per Mile. Passenger.	Freight equal to Loaded.	Nos. of Engines.	Remarks.
—	5,086 47	4,278	1,239	401	In good order.
—	3,120 28	—	1,229	402	In fair do.
—	2,212 93	—	—	403	In good do.
—	2,814 18	—	1,653	404	Do. do. Had general repairs and new fire box.
—	2,988 45	—	1,060	405	Do. do.
—	2,807 86	3,238	1,877	406	Do. do.
—	2,737 78	1,529	1,492	407	Do. do.
—	3,145 18	—	1,814	408	Do. do. Had general repairs.
17,250	2,950 1[illegible]	—	1,465	409	Do. do.
—	2,233 5[illegible]	—	—	410	Do. do.
—	1,994 51	—	—	411	Do. do.
210	2,950 81	—	3,267	412	Do. do.
—	2,450 2[illegible]	—	—	413	Do. do.
—	3,951 8[illegible]	—	1,653	414	In fair do.
—	2,614 8[illegible]	—	1,583	415	Do. do. Will soon require new fire box.
21	3,031 8[illegible]	—	1,047	416	In good do. Had general repairs.
—	3,511 4[illegible]	—	1,207	417	Do. do. Had general repairs and new fire box.
—	2,732 0[illegible]	—	937	418	Do. do.
952	3,496 4[illegible]	—	1,255	419	Do. do. Had general repairs and new fire box.
—	2,857 9[illegible]	—	901	420	In shop for general repairs.
—	4,889 0[illegible]	4,374	—	421	In good order. Had general repairs.
206	2,998 5[illegible]	—	932	422	Do. do.
70	2,853 8[illegible]	—	872	423	Do. do. Annual premium, freight engine.
—	3,411 3[illegible]	—	1,259	424	Do. do.
—	2,987 4[illegible]	3,247	1,255	425	Do. do. Had general repairs.
—	3,601 9[illegible]	—	926	426	In shop for general repairs.
—	3,455 7[illegible]	—	1,955	427	In good order.
—	3,441 8[illegible]	12,274	966	428	Do. do.
513	3,547 4[illegible]	2,914	1,296	429	Do. do.
19,222	**[illegible],876**				

84,510	- - - 14,537
368,192	- - - 10,873
93,981	- - - 12,902
19,222	ines, and included
565,905	

representatives from each interested railway. Each road would furnish its own share of cars, to be painted a uniform colour, and bills of lading and forms all printed in the same colour. This corporation contracted for the through delivery of goods, but required prepayment.

The merit claimed for this system as against the Empire Transportation Company's system is that under it the sole cost to the railway is the actual expense of its operations; whereas some allowance must be made to the Empire Transportation Company, which is a separate private corporation, for its expenses and profit out of the rates charged.

Against this the Empire company allege that larger net earnings to the railway company result from the greater energy of action of a private corporation in endeavouring to secure traffic; but that however this might be, the conflicting interests of the railways over which the company works would have prevented coöperation.

The Empire company furnishes all the cars required for its traffic. It possesses pipe lines for bringing the oil down from the oil regions to the road or river. It has its own stations for goods in New York, with its ferry boats to cross the river, and a special oil depôt at Communipaw for petroleum traffic. In New York harbour, warehouses are provided for the storage of petroleum in packages, and iron tanks for the petroleum in bulk, with facilities for the direct discharge into vessels alongside the shipping pier of petroleum destined for shipment. It has also a station at Baltimore. It has a subsidiary agency for the traffic on the lakes, for the carrying on of which it possesses from 16 to 20 steam-propeller boats, and wharves and elevators for grain at Erie. Rolling Stock, &c. Stations, &c.

The company exhibited its cars; its petroleum oil transportation, both by car and pipe lines; and models of its shipping piers, its elevators, and steam propellers. Exhibits.

Cars.—These are of the standard pattern. A large number have been specially fitted for traffic in fresh provisions and perishable articles. They are double throughout, lined with a non-conductor of heat, and fitted with ventilators at the top. The tank car for petroleum consists of a wrought-iron boiler on trucks, the boiler having a capacity of 3,600 gallons. The boiler is fitted with a man-hole, expansive double valve, &c., and needs the best material and workmanship to secure its contents from leakage. Cars.

Oil Pipe Lines.—The following is the mode of collecting the oil by means of the pipe lines and loading it into the cars. The pipe used is of wrought iron lap welded, usually two inches diameter, put together with a screw sleeve joint. The main pumping line or lines are run from the centre of production by the most direct route to the railroad station. The pipe is laid along the surface of the ground, except at road crossings or where protection is necessary. At the railroad large iron receiving tanks are erected varying from 5,000 to 20,000 barrels capacity each. These tanks are placed at a sufficient elevation above the railway to permit their contents to be run by gravity through pipes to the loading racks, where the cars stand in sidings adjacent to the railway. At the necessary intervals along the pipe line pumping stations are established for the reception and forwarding of the oil. The equipment of the main stations consists of a pump-house, with two or more powerful pumps worked by steam; two tanks of from 500 to 2,000 barrels capacity each in a substantial tank house; a telegraph office, and a building to accommodate the employé in charge. From each such station, branch connecting lines lead off in every direction to the hundreds of wells that are tributary to it. At each well, accurately gauged storage tanks are fixed, to which the pipe line branches are attached. Before commencing to draw oil from these tanks their contents are measured and recorded; another measure and record is made after the pipe line ceases taking oil from them, and the difference in inches between the two measures forms a basis of credit to the well owner in the company's books. A memorandum receipt, known as a gauger's ticket, is given to the well owner at the time the oil is run into the pipe line, and a negotiable certificate for all or any part of the oil credited to the well owner on the company's books is issued on call at the pipe company's central office or on telegraphic request. All petroleum received goes into a common store from which deliveries are made in accordance with orders received from the owners. Oil Pipe Lines.

In 10 years 375,810,551 Gallons Crude Petroleum passed through Empire Transportation Company's pipes.

The average capacity per 24 hours of a single main of two-inch pipe may be considered as about 40,000 gallons. From 1866 to 31st March 1876 the oil passed through the Empire Transportation Company's pipes amounted to 375,810,551 gallons of crude petroleum. The quantity of petroleum held in store in tanks located in the Pennsylvania oil region may be stated as averaging from 80,000,000 to 120,000,000 gallons. In case of the conflagration of an oil tank the loss is shared by the owners, in the ratios of the relative quantities of the oil held for them at the time. From Karns city to the Alleghany Valley Railway the charge made for the use of the pipe line was 30 cents per barrel, an allowance of a little over two per cent. being made for leakage and waste.

Elevators for Grain.

Elevators for Grain.—The following is the description of one of the company's elevators at Erie. The structure is framed, 96 feet long by 72 feet wide enclosed by a brick fire wall, and it has a slate roof. The main building is 109 feet and the tower 124 feet high. Forty-seven separate bins furnished an aggregate storage capacity of 250,000 bushels, and the transfer capacity direct from the lake to the rail may be estimated at 100,000 bushels per each 24 hours. A steam-engine furnishes the power requisite to do the work of the building. The plan of operating the elevator is as follows:

A moveable ship-leg, containing an endless five-ply rubber belt, 157 feet long and 17 inches wide, on which 154 metal buckets of nine quarts capacity each are secured, is lowered from the building into the hold of an adjacent grain-loaded vessel; the belt is then started and elevates the grain to the hopper of a 100-bushel receiving scale located in the elevator tower, where it is weighed; after weighing the grain is dropped by gravity into an iron receiver, located below the floor of the building. From this receiver it is elevated on another similar bucket belt to a large distributing bin at the top of the house. From this bin the grain is spouted by gravity into any one of the numbered storage bins, from which it is again spouted (direct into cars) when ready for shipment by rail. Two railroad tracks, accommodating six cars at a time, are located in the building below the storage bins. On each railroad track there is a track scale of the most approved pattern, which is frequently tested by sealed weights and kept in perfect repair. The light weight of each car is taken on entering the building, and the loaded weight as it passes out, the difference giving the weight of the grain. Each lot of grain is kept entirely separate and distinct from every other, no mixing or grading of grain being allowed. A small sample is taken from each lot of grain handled, and is preserved for reference if desired. Great attention has been paid to making the most perfect provision against fire.

Extent of Operations.

It will be seen that the organisation of the Empire Transportation Company is on a larger scale than that of any carrying company in Great Britain. Its functions are the result of the spread of the American railway system, the features of which are very different from our system. With us the railway companies have discouraged the private carrying companies from using the railways, and have preferred to take the whole carrying trade and profit into their own hands. Whether the American railway companies will do that eventually or not, it would seem, for the immediate future that it would be worth considering whether this organisation could not be utilised for the purpose of regulating the ruinous competition which has prevailed between the principal east and west routes terminating in New York and Philadelphia. If these companies would refer to arbitration the share which each should have of the through east and west traffic, and then place the agency for this through trade and the division of receipts in the hands of a large company like the Empire company, it might prevent the recurrence of the recent difficulty.

Railroads on the Narrow or Three-Feet Gauge.

Three-feet Gauge Railways.

It will have been seen from the tabular statement of the locomotives exhibited that several were for railways on the narrow or three-feet gauge in America; it will, therefore, be desirable to explain the position which these railways have assumed in the United States.

Within the last few years a considerable development has taken place of railways on a three-feet gauge in America. It seems curious that we have no sooner ended the controversy between the broad and narrow gauge in this country by the adoption of the 4 feet $8\frac{1}{2}$ inches standard, than a new controversy has sprung up between the advocates of that gauge and a smaller one.

This controversy has points of interest for us in connexion with the question now of daily occurrence as to how to connect small centres of population with our railway system at a moderate cost, and it has further points of interest in connexion with our colonial possessions and India; for if it can be shown to be advantageous in America it would be also advantageous in colonies where the circumstances are similar.

Reason for their introduction.

As I have already observed, in England the railway is required to accommodate an established population, but in the colonies, as in the United States, the railway is at first simply the road of the pioneer. The business of the railway there is to develop the country by enabling a population to enter it. Such a road must be constructed as cheaply as possible. In fact, cheapness is the first consideration. After the road has been made, a population developed, and revenue obtained, progressive improvements must take place in the line. The railways which have developed the United States have practically had to be reconstructed from their original form as population and traffic has increased.

With these preliminary remarks, I will proceed to describe the narrow gauge or three feet railways of the United States at the present time.

7,973 miles Narrow Gauge in operation, or in course of construction.

There are companies formed to build about 7,973 miles of these narrow gauge lines. Of these there are about 2,700 miles at present in operation. The Denver and Rio Grande is proposed to be about 1,700 miles long, and of these 210 miles are completed.

It is difficult to give a general summary of the cost of this line because the capital expended in almost all cases includes works on the portions of line which are still in progress.

Cost of Narrow Gauge per mile.

The estimate of the probable cost which the promoters of the narrow gauge system give is as follows:

Road per Mile.	£
Grading	440
Rails (30 lbs. to the yard)	816
Fish plates, fastenings, &c.	87
Cross-ties (2640)	160
Bridging and culverts	80
Track laying and surfacing	80
Engineering	50
Right of way	60
Station houses, water station, &c.	75
Sundries	56
	£1,904
Extra for 40 lb. rail	240
	£2,144

Rolling Stock per Mile calculated on 100 Miles of Road.	£
Locomotive	248
Coal cars	270
Flat cars	58
Box cars	104
Passenger cars	150
Baggage cars	84
	£758 per mile.

Thus the promoters of the narrow gauge assume about 1,900*l.* per mile of line with a 30 lb. rail, and about 758*l.* per mile for rolling stock.

No doubt the reductions in cost of construction from the narrow gauge are due mainly to saving in breadth of the line. But the width of road bed for the three-feet gauge would be 12 feet as against $14\frac{1}{2}$ for the standard gauge for one track, and 21 feet as against 26 feet for the double track. With a less width there would be no margin for slips. If these dimensions be applied to cuttings the following would be the number of cubic yards per mile of excavation in each gauge respectively, with average depth of cutting of five feet and 20 feet and slopes of one to one:—

	Single track.		Double track.	
	Width, feet.	Cubic yards.	Width, feet.	Cubic yards.
5 feet deep:				
Standard gauge -	14½	9,533	26	15,155
Narrow gauge - -	12	8,311	21	12,712
Excess in standard -	—	1,222 or 15½ per cent.	—	2,444 or 9¼ per cent.
20 feet deep:				
Standard gauge -	14½	67,466	26	89,955
Narrow gauge - -	12	62,577	21	80,177
Excess in standard -	—	4,889 or 7¾ per cent.	—	9,778 or 12¼ per cent.

It will thus be seen that reduction in this item will not in reality be in the direct rate of diminished gauge. Moreover, the cheaper permanent way depends on other conditions, viz., weight and speed of rolling stock. The limit of weight in rolling stock depends on the adhesive power of the engine, which must be sufficient to draw the traffic, consequently with light traffic the permanent way on the standard gauge need not be materially heavier than that of the narrow gauge.

Montrose Railroad. Parker and Karns City R. R.

The lines the particulars of which I have been able to obtain are the Montrose Railroad and the Parker and Karns City R. R. These lines are of different characters.

The Montrose R. R. is 28 miles long, and cost a little over 2,300*l.* per mile, including equipment of two locomotives, two passenger cars and baggage cars, and 13 freight waggons. This line is situated in an agricultural country. It runs from the Tunkhannock station of the Lehigh Valley Railway to Montrose, which is 28 miles distant, and at a considerable elevation. The line follows closely the contour of the country, and works round the heads of ravines in a very striking manner; it has necessarily one or two viaducts. The traffic is mainly agricultural.

The Parker and Karns City R. R. is 10 miles long, and is to be extended immediately for a further distance of 17 miles. It cost 5,500*l.* per mile, including equipment of four engines, five passenger cars, and 46 freight cars. The line has a viaduct of 400 feet long and 74 feet high. It follows very closely the contour of the country. This line is mainly for the development of a region of oil wells opened somewhat recently. The goods traffic is mainly upwards to supply the wants of the new settlers. The oil is carried in pipes to main stations of the Alleghany Valley Railway, which is near.

Curves and Gradients.

The curves on these lines are in some parts of 120 feet radius, and the gradients occasionally as steep as 1 in 40.

Comparisons of Rolling Stock for 3 feet and 4 feet 8½ inch Gauges.

The following is a comparison of the particulars of the rolling stock for the 3 feet and 4 feet 8½ inch gauges:—

	Passenger engine for 3 foot gauge. for 30 lb. rail. 4 wheels coupled.	Passenger engine for 3 foot gauge. for 40 lb. rail. 4 wheels coupled.	Average for 4 ft. 8½ in. gauge.
Diameter of cylinder -	8 in.	10 in.	17 in.
Length of stroke -	16 in.	26 in.	24 in.
Rigid wheelbase -	6 ft. 6 in.	6 ft.	8 ft. 6 in.
Total wheelbase - -	12 ft. 0 in.	15 ft. 10 in.	22 ft. 5 in.
	3 ft. or 3 ft. 4 in.	3 ft. 8 in.	5 ft. 2 in.
Weight on driving wheels	20,000 lbs.	24,000 lbs.	45,800 lbs.
Weight on pony truck -	4,000 lbs.	8,500 lbs.	25,500 lbs.
Total -	24,000 lbs. or 10 tons 1 cwt.	32,500 lbs.	71,300 lbs.
Weight per wheel on drivers.	5,000 lbs. or 2 tons 4½ cwt.	6,000 lbs. or 2 tons 8 cwt.	112,000 lbs. or 5 tons

	6 wheels coupled. Freight engine. Rails 25 lbs.	Mogul pattern. 40 lbs. rail.	Mogul pattern. 6 wheels coupled.	8 wheels coupled.
Cylinder	9½ft. to 14 ft. stroke	12 in. × 16 stroke.	18 in. × 24 in. or	20 in. × 24 in.
Diameter of driving wheels.	2 ft. 9 in.	3 ft. to 3 ft. 10 in.	4 ft. 6 in.	4 ft. 2 in.
Rigid wheelbase	7 ft. 8 in.	9 ft.	15 ft.	13 ft. 8 in.
Weight all on wheels	20,000	Driver - 34,000	Driver - 68,000	79,400
		Truck - 4,000	Truck - 12,000	12,240
		Total - 38,000	Total - 80,000	91,640
Weight per wheel	3,333 lbs. or 1 ton 2 cwt.	5,666 lbs. or 2 tons 1 cwt.	11,338 lbs. or 5 tons 1¼ cwt.	9,925 lbs. or 4 tons 1 cwt.

Hauling capacity—

on level	468 tons	795 tons
on incline of 1/130	145 „	250 „
on „ 1/50	63 „	109 „

The consolidation pattern engine hauls over line with maximum gradients of 1 in 69 a gross weight of 476 tons.

Low Centre of Gravity.

It will be seen from this that the principle adopted in these narrow gauge engines is to keep the centre of gravity low, and to diminish the weight on each driving wheel, to a little over 2 tons. The rigid wheel base is diminished so as to facilitate passing round curves. In the cars for the narrow gauge the wheels are made 24 inches diameter instead of 36 inches, which is the usual diameter for passenger cars on the standard gauge. The usual system of a long body placed swinging truck is in use. The original cars were 35 feet long.

Weight of Cars.

The weight of the cars is from 15,000 to 17,000 lbs., carrying 36 passengers, or say from 410 to 470 lbs. in dead weight per passenger. In those that I saw the sizes and scantlings were all reduced in proportion to gauge. The 4 ft. 8½ in. car carries from 50 to 70 passengers, and weighs from 28,000 lbs. to 33,000 lbs., *i.e.*, from 500 to 600 lbs. dead weight per passenger.

Width of Car.

The narrow gauge car is 7 feet wide. The width of 7 feet allows double seats on one side 36 inches wide, and single seats on the other 19 inches wide, with an aisle between 17 inches wide. In order to balance the carriage the arrangement is reversed in the middle of the car. The width of 7 feet was fixed upon the principle of making the width of the car little over double the width of the road, but the width has since been increased to 8 feet in order to seat 4 passengers abreast; the number of passengers is thus increased to 47, without a proportionate increase of weight. The height of the centre of the draw-bar and buffers is 24 inches above the rail. The freight cars are 23½ feet long and 7 feet wide, the wheels are 20 inches diameter, but recently wheels of 24 inches diameter have been introduced.

Length.

The following show a comparison between the weights and carrying capacity of some of the cars :—

Gauge.	Weight of Car in Lbs.	Capacity in Lbs.	Total Weight.	Proportion of dead Weight to paying Loads.
Flat car:				
4 ft. 8½ in.	16,000	20,000	36,000	1 to 1·25.
3 ft.	7,500	19,000	26,500	1 to 2·5.
Box car:				
4 ft. 8 in.	17,000	20,000	37,000	1 to 1·17.
3 ft.	10,000	17,600	27,600	1 to 1·6.
Coal car:				
4 ft. 8½ in.	17,000	30,000	47,000	1 to 1·7.
3 ft.	9,000	20,000	29,000	1 to 2·2

On the Denver and Rio Grande Railroad it is stated that 16 cars on the 4 ft. 8½ in. gauge unload and fill 20 cars on the 3 ft. gauge. Thus say—

Empty Weight.	Paying Loads.	Total dead Weight.	Total paying Load.	Total Cars and Load.
	Tons.	Tons.		
16 wide gauge, 8½ tons -	10	136	160	296
20 narrow gauge, 5 tons	8	100	160	260
		Saving in total weight -		36 tons.

which is equivalent to 22 tons additional freight, or 23 per cent. more, assuming the cars loaded to the full capacity, and the comparison is more favourable when the cars are not filled.

It will be seen from these figures that the narrow or 3 ft. gauge cars as at present constructed carry a larger proportion of paying load to dead weight than the cars of the standard or 4 ft. 8½ in. gauge.

Increased weight of Rolling Stock.

But these railways have only been in operation for a very limited time. The stock on the 4 ft. 8½ in. gauge has materially increased in weight since the commencement of the railway system. Indeed the weights have increased by one half, and in some cases doubled, since I was in America in 1856. This increase has been caused simply by the necessity of adopting a greater degree of strength in order to resist the shocks received in the course of traffic.

The narrow gauge cars have been constructed hitherto on the principle of reducing the dimension of the rolling stock in proportion to the reduction of gauge. But inasmuch as the promoters of the narrow gauge claim that they can carry the weights in the cars which I have shown, and as they state that speeds of from 15 to 20 miles an hour will be maintained, it is clear that an increase of weight may be expected, except so far as a saving may arise from the diminished size of wheels.

The narrow gauge lines which I inspected followed with great ease the contour line of the ground, and if the cars are kept narrow, the width required for the formation of the lines would be narrower than for the 4 ft. 8½ in. gauge. But the width of the cars is being gradually approximated to that of the 4 ft.

Unstability of Cars 8 feet in width.

8½ in. gauge, consequently that source of economy must disappear. Cars of 8 ft. wide with a base of 3 ft. are moreover unstable, and moreover whatever proportion between the width of gauge and width of car be safe on the 3 ft. gauge, it will be equally available for adoption on the 4 ft. 8½ in. gauge.

Facility of passing round Curves.

I may mention in connexion with this that the facility of passing round curves is much increased on the United States Railways by the short amount of rigid wheel base in American rolling stock as compared with that of English

Radial Axles.

carriages and wagons. The use of radial axles however diminishes the difficulties of a long rigid wheel base, moreover in America experiments have been made which tend to show that axles may be introduced on which the wheels have a power of motion independent of each other.

West End Railroad Company.

A train with such wheels and axles was, as I have already mentioned, running on the narrow gauge railway at the Centennial Exhibition; and a pair of wheels with these axles, viz., the Miltimore axle, were exhibited, which had been in use for several months, and had run 12,000 miles in ordinary trains. In connexion with radial axles this arrangement, if it can be perfected, will enormously diminish the resistance on curves. Consequently in practice it may be assumed that, where economy requires it, the 4 ft. 8½ in. gauge could be laid with curves little less sharp than those of the 3 ft. gauge.

Measure of Locomotive Power.

The weight of the rail depends entirely on the weight on any one of the wheels of a train. The light locomotives on the narrow gauge do not require heavy rails, but the measure of the power of a locomotive to draw a train up an incline is practically the weight upon its driving wheels. The light locomotives can only draw light weights up the inclines in use on mountain narrow gauge lines.

There is one advantage of the 3 ft. gauge in the United States for lines of small traffic which would not be so apparent in this country, viz., the convenience of having smaller cars to move about at the stations. The very long carriages in ordinary use on American railways are somewhat cumbrous for places of small traffic.

Break of Gauge. The break of gauge entails the cost of transhipment at junctions. The inquiries I made show that the cost of transhipment in the United States may be assumed at from 10*d*. a ton in cases of regular traffic to 1*s*. 6*d*. a ton in cases where traffic is slack or intermittent.

Concluding Remarks on 3 feet and 4 feet 8½ gauges. These narrow gauge railways have been constructed in the United States as economical pioneer lines; and so long as they are retained in that capacity, they may be useful for opening out a country where the traffic is small; but they must be kept in their proper place; and they must not, as they seem to be somewhat inclined to do, copy the frog and the bull in the fable, and attempt to swell out their rolling stock to do what the 4 ft. 8½ in. gauge can do.

It is quite certain that in districts where the traffic increases and becomes of real importance, it will be necessary that these narrow gauge lines be reconstructed and converted into lines of the 4 ft. 8½ in. gauge, and in such cases the narrow gauge stock will become an incubus; on these grounds therefore it would seem preferable to construct light railways on the standard gauge, instead of railways on the narrow or 3 feet gauge.

Traffic.

Variation of Tariff. The tariff on the railways of the United States varies very considerably. From two to three cents, or 1*d*. to 1½*d*. per mile is a frequent tariff, but with competing lines of course a very different tariff prevails.

Non-division of Classes. The only division of classes which prevailed on American railways when I was there 20 years ago was the emigrant class, which is carried at a much lower rate than the other class; but it was then the custom to reserve cars for the ladies and for gentlemen who accompanied them. Now the railroad corporations have created a first class far more comfortable and luxurious than the first class on our railways, by the adoption of the saloon car or the Pullman car, for the use of which a special charge is made by the owners of the car apart from the fare. **Pullman Car Company.** On railways which have not made terms with the Pullman Car Company, cars equally comfortable are run, on certain through trains, which are nominally owned by the officers of the company, so as to evade the State law where it does not recognise a differential fare.

I do not propose to enter here into the general question of charges for freight. It is, however, of interest to allude to a few points connected with goods and mineral traffic:—

1. The question of coal.
2. Grain traffic to the east.
3. The laws passed in the Western States for enabling local traffic to participate in the benefits of low rates charged on competitive through traffic.

Coal question. 1. *Coal.*—The coal question assumed considerable prominence in Massachusetts from the fact that certain towns which were essentially manufacturing towns, of which Lowell is a type, had depended for their progress on water power. When the growth of the towns had exhausted this power, the use of steam became essential to their further progress. The price of coal for inland towns was regulated by the charges for transport, but seaboard towns obtained coal from Pennsylvania by sea. **Lowell and Fall River.** Lowell was 26 miles from tide water. Fall River was on the southern seaboard. In 1865 Lowell had 385,412 spindles and Fall River 241,218. Seven years later the spindles in Fall River had increased to 1,017,144, whilst those in Lowell had only increased to 570,586. This rapid progress in Fall River was due simply to the cheaper supply of coal.

Manufacturing Industries of Massachusetts. The desire of a cheap tariff for coal in Massachusetts results from the great increase of its manufacturing industries; this increase is very forcibly illustrated by the fact that whilst the development of industry in the State between 1848 and 1865 had risen from \$125,000,000 to \$520,000,000, to that increase the original industries of the State, viz., agriculture and fisheries, had contributed $\frac{1}{80}$ per cent. only, foreign commeree had contributed 3½ per cent.,

but the manufacturing production had undergone the amazing development of $326,000,000, or 77 per cent. of the whole.

Proposals for cheap Conveyance of Coal.

Various proposals have been made for the cheap conveyance of coal to the New England States, amongst others, that of narrow gauge coal lines from Pennsylvania. It seems almost unnecessary to point out that if any line were made for the special conveyance of coal it should be at least on the 4 ft. 8½ in. gauge.

Extent of Coal Region.

With the exception of the New England States, coal extends largely under most of the North-eastern States of the Union. In Pennsylvania coal is largely worked.

Railroad Corporations owners of Coal Mines.

Of the railroad corporations in that State, there are some that owe their existence to having been previously owners of coal fields, such as the Delaware and Hudson Canal and Coal Company, the Delaware, Lackwanna, and Western Railroad, and the Pennsylvania Coal Company, whilst the Lehigh Valley Railroad, the Philadelphia and Reading Railroad, the Central Railroad of New Jersey, and the Pennsylvania Railroad, have become possessed of coal lands. The Philadelphia and Reading has indeed so fettered itself by the acquisition of coal lands and agreements with manufacturers, that owing to the present stagnation of trade, it has been temporarily obliged to suspend dividends on ordinary capital. With a revival of trade a great future is before it.

These railroad corporations, being so largely interested in the coal trade, entered into an arrangement termed the Coal Combination, by which they regulated the prices and the output of all the collieries on their lines, owners of private collieries being compelled to accede to the arrangement because the monopoly of transport lay in the hands of the companies.

Such an arrangement shows to what lengths railroad corporations, possessing a complete monopoly, might carry their control over produce and manufactures. In this case an agreement between six corporations ruled the price of a commodity of the highest importance for manufacturing and domestic purposes.

The stress upon the arrangement came when, owing to incidents of trade, the amount carried by one of the corporations was larger than what the united companies had decreed as its share, and on the refusal of that corporation to reduce the quantities carried, the association has recently broken up. It is alleged, however, that a renewed arrangement is in contemplation.

Grain Traffic, Routes.

2. *Grain.*—The grain traffic from the west to the east lies over five routes. The Baltimore and Ohio, viâ Newark and Sandusky; the Pennsylvania, viâ Fort Wayne; the Erie and its connexions; the New York Central and Lake Shore; the Grand Trunk of Canada and Michigan Central. Moreover, the Lehigh Valley Railroad possesses a route on the Erie road to the lakes; and the Erie Canal affords a water route, viâ the Hudson River.

Grain 18 days to Liverpool from West.

These railroads have been carrying the grain as through traffic, during last summer, at ruinously low rates in competition. The system is to retain the grain in the west. When ordered for Europe it is put in cars and brought straight to New York or Philadelphia for shipment, and thus there is no warehousing until the grain reaches Liverpool. It is calculated that grain can reach Liverpool in 18 days from the west. Of course the low transportation rates charged during the summer have answered well for farmers and shippers of grain, but unless remunerative for the railroads these low charges cannot be maintained.

Cost of Haulage.

I was informed by the Pennsylvania Railroad Company that the cost of haulage per ton per mile, including all expense of haulage, in 1875, was 3 mils = ½*d.* per ton per mile; therefore, at this rate the actual haulage would be covered by a charge of $2·25 from Chicago to Philadelphia.

There appears, however, to be a strong conviction that the western farmer cannot sell his grain in good years at such a price as will pay a fair rate for carriage to the railroad company as well as enable the farmer to obtain a footing in European markets with a reasonable profit to himself. He finds it better to feed and sell the resulting meat. If this be so, it would seem that the best prospect for the western farmer is to look for a market in the establishment of manufactures and the development of the coal fields of Illinois, near the seat of his produce.

Legislation on Traffic in the Western States.

Legislation on Traffic in the Western States.—The problem of railway legislation in the United States differs from that in this country. In Great Britain the

whole mileage of railways is about 16,400 miles. The legislation upon railway matters is regulated by the Imperial Parliament, and is consequently uniform over the whole country. In the United States there are now about 74,000 miles of railway in operation, and each state is self-contained as regards its legislation. The railroad may, however, pass through several states or territories. Railroads, of which the whole line is within the confines of one state, are subject to the laws of that state only; but the railroad corporations whose lines lie in more than one state, become subject to the laws of these several states. In this matter of railway legislation each state has commenced from its own stand-point; consequently there has been no uniformity in the original legislative action of the several states; moreover rapid alterations have occurred in the legislative proceedings taken by each state with respect to railroads. The Federal Government legislates upon railroads in the territories, but when the territory expands into a state, the state legislature takes up the legislation. The chairman of a leading English railway has said that so long as Parliament is sitting no railway property is safe in this country; this saying is, however, far more applicable to railroad property in the United States, owing to this diversity of legislative action in the several states, and owing to many of the state legislatures being in the hands of a class who do not always possess practical knowledge of the commercial wants of the community, but seem to be ready to make experiments without considering the resulting effects which the experiment may have on the confidence of the moneyed classes. If space permitted, it would be interesting to trace the alterations in the railroad legislation in the several states, and the effect on railroad property. I must limit myself here to alluding to the legislation which took place a short time ago in some of the Western States with the object of preventing the railroad corporations from charging differential rates.

The history of this legislation deserves careful study by those in this country who would fetter the discretion of railway companies in charging what rates they please within the maximum rate authorised by Parliament.

Action by States Legislatures.

In consequence of the severe competition between certain railroads in the Western States and also railroads running thence to the eastern seaboard, very low rates were charged between competing points, whereas higher rates were maintained for shorter distances where there was no competition. This is a practice which has been recognised as admissible by the Court of Common Pleas in this country, under the Railway and Canal Traffic Act. In 1871 and 1872 the States of Illinois, Iowa, Minnesota, &c. passed general Acts in which it was enacted that no railroad corporation organised or doing business in the state should charge for the transportation of goods or property on its road for any distance the same, nor any larger amount, as toll or compensation than is at the same time charged for the transportation of similar quantities of the same class of goods over a greater distance of the same road.

State of Illinois.

In 1873 the State of Illinois altered this enactment to the extent that they published in a new Act a tariff of rates and a classification of articles; the Act, however, does not make the tariff compulsory, but allows the railroad corporation to fix their own rates and charges; where however, there is a conflict of opinion as to the reasonableness of their rates and charges, the law makes the schedule in the Act, not absolute, but *primâ facie* evidence of a reasonable rate of charge; the law also makes the charging more for transportation to an intervening or non-competing place than is charged for transportation to a greater distance, *primâ facie* evidence of unjust discrimination.

State of Iowa Classification of Railroads.

In Iowa the Act of 1874 publishes a schedule of rates, and a classification of goods which it fixes as absolute. It divides the railroads into three classes: Class A. carry $4,000 a mile a year and over, Class B. carry $3,000 a mile a year and over, Class C. earn less than $3,000. The passenger rates are fixed at 3 cents per mile per passenger, with 100 lbs. of luggage for Class A. 3½ cents for Class B. 4 cents for Class C., children under 12 half-price. 10 cents extra allowed to be charged if tickets are not taken before starting. The maximum charge for goods is to be, for Class A. railroads 90 per cent. under, for Class B. 5 per cent. over, and for Class C. 20 per cent. over, the published schedule. The railroad corporation being allowed to charge what they choose within this maximum. I understand a similar law has been enacted in Minnesota. It is worthy of note that in the case of certain suits instituted in

Illinois to enforce these new laws, the Bench enunciated the opinion that a railroad being an artificial person created by the legislature, cannot have higher rights than an individual person; that no individual can have any rights except those conferred by the constitution; that railways are public institutions, and receive their title and property only for the public use; that the property thus intrusted to railroad corporations is to be used by them as a part of the public domain controllable by the legislature; that the character of railroad corporations does not grow out of the fact of their incorporation, but out of the manner and object for which they are created; the right to control them by the law-making power of the state is not founded on their being incorporated, but on their being the instruments of Government created for its purposes, and because in their relations to the state they are public institutions. These views deserve the careful attention of intending investors in western railroads.

Conclusion.

Concluding Remarks.

I have endeavoured in these remarks to show the present condition of the railway system of the United States as compared with what it was when I reported upon it to the Board of Trade in 1856.

The relation of the railways to the public involves problems more complex in America than in this country, because the territory is so vast, the corporations are so numerous, the interests of the various districts are so diverse, and each State's legislature has its own views of the question of railway legislation. Moreover the necessities of the country have required a mode of original construction which entails a large subsequent outlay to perfect the system.

Under these circumstances the foreign capitalist who may have invested at a high rate of interest, imagining that his security was as safe as that of an English railway debenture, may have been sometimes disappointed. There are however lines which are as sound financially as our own leading railways. It would be prudent in English investors to confine themselves to those, and leave it to persons on the spot to support newer and less known railways.

12, Chester Street, S.W.,
January 1877.

Douglas Galton.

To
Colonel Herbert Bruce Sandford, R.A.,
British Executive Commissioner,
Philadelphia International Exhibition.

Colonel RICH, R.E.

VESSELS AND APPARATUS OF TRANSPORTATION.

REPORT on "VESSELS and APPARATUS of TRANSPORTATION," shown at the CENTENNIAL EXHIBITION, PHILADELPHIA, 1876. By COLONEL F. H. RICH, R.E., of the Board of Trade.

SIR, International Exhibition, Philadelphia, 1876.

IN accordance with the request contained in your letter of the 29th June, I have the honour to submit a report on the exhibits that appear to me to deserve special notice in Group XIX, of which section I was one of the judges and chairman (the other judges being H. C. Goodspeed, Salt Lake City, Utah, U.S., J. W. Griffith, Portsmouth, New Hampshire, U.S., Isaac Newton, New York), so that it may be laid before the Lord President of the Council if desired. Judges, Group XIX.

The exhibition in this section of engineering was not large.

I propose to take the subjects in the class order in which they are grouped in the Official List.

There were 158 Exhibits in Group XIX submitted to the judges before I left Philadelphia at the end of July; of these, Total Exhibits, 158. Exhibits in Group.

7 were in Class 596, which comprises Vessels for carrying Telegraph Cables and Railway Trains, also Coal Barges, Water Boats, and Dredging Machines, Screw and Floating Docks and for other special purposes. Cl. 596.—7.

62 in Class 594, which comprises Boats and Sailing Vessels used in commerce, Sailing Vessels used in war, Yachts and Pleasure Boats, Rowing Boats of all kinds. Cl. 594.—62.

15 in Class 595, which comprises Steam Ships, Steam Boats, and all Vessels propelled by steam. Cl. 595.—15.

12 in Class 554, which comprises Screw Propellers, Wheels for the propulsion of vessels, &c. Cl. 554.—12.

16 in Class 597, which comprises Steam Capstans, Windlass, Deck Winches, and Steering Apparatus. Cl. 597.—16.

46 in Class 287, which comprises Ropes and Cordage. Cl. 287.—46.

There were no exhibits submitted in Classes—

590—Suspended Cable Railways.
591—Transporting Cables.
592—Balloons, &c.

Class 596. Dredging Machines.

The Dredging Machines of the American Dredging Machine Company consist of a large iron bucket, fixed at the end of a beam, which is managed and worked by steam machinery. These machines are simple and moderately cheap, but they are only suitable for working in smooth water. They are particularly well adapted for dredging out Docks or Lay-Bies for vessels on the banks of rivers. The machines are very efficient in clearing out corners.

Floating Docks.

There are several models of Floating Docks, amongst which is the Bermuda Floating Dock. The models of a Gridiron Floating Dock and Staging for Dry-Docking vessels, which are exhibited by Messrs. Clark and Standfield, of London, deserve particular mention on account of the novelty and simplicity of construction and the comparative small cost at which a large number of vessels could be dry-docked. The one Floating Dock can be used for placing as many vessels on the staging as the latter is constructed to hold.

Class 594. Models of Sailing Vessels.

The exhibits in this class consist of Models of Vessels executed with more or less care and accuracy of detail. No data, on which to form an opinion of their relative merits, was furnished in the greater number of cases. Amongst these, the Models and worked out drawings of Mr. Arenty of Norway, appeared to be the only ones in a complete state and deserving of special notice.

Paper Boats.

The Paper Boats exhibited by Messrs. Waters and Sons, of Troy, are a novelty. They are made of coarse paper put together with shellac, are very strong in proportion to their weight, and are likely to be useful for shooting Punts, travelling Canoes and racing Gigs. These boats are very easily repaired. The paper of which they are made is of two sorts. One kind is made from Manilla Grass and the other from Russia Duck. It is rolled in sheets 80 in. wide and of any length required.

Rowing Apparatus

The Rowing Apparatus or Mr. Lyman, of Hamburg, New York, called "Bow facing rowing Machinery" is a new invention and deserving of notice, as likely to be useful for shooting punts and all pleasure boats rowed by only

one person. The oar is cranked or made in three pieces, with two hinge joints near the rullock, so that the oarsman, by the same motion of his arms as in ordinary rowing, pulls the boat in the direction that he is facing, instead of backwards, as he does with the common oars.

Class 595. Models of Steamships, &c.

The exhibits in this class consist of a large number of models. The model of the ship Frisia, exhibited by the Hamburg Steam Ship Company, is a very nice piece of work, the details appeared to be most accurately carried out.

Class 554. Steam Lauuches.

Two full sized Steam Launches or Yachts are exhibited in this class. They are open boats for river use and are well built. One of them is reported to steam 20 miles an hour in smooth water, but there was no opportunity of testing this, as these boats were placed in the Machinery Hall Building of the Exhibition. Major Mallory, of Bridport, Connecticut, exhibited a Screw Steam Yacht, in which the screw, not only propelled the vessel, but also acted as a rudder. The screw can be moved to either side in a half circle, as the screw shaft is pivotted near the stern. The yacht was afloat in the Delaware River. It could be turned round (the whole circle) by means of the screw, in a little more than its own length, in 1 and 45 seconds. This invention may probably be usefully applied to dockyard launches, and for intricate river navigation, as the screw forms a most powerful and effective rudder. The length of the yacht is 95 feet over-all, and the length of keel is 84 feet.

Screw acting as Rudder.

Monitor Life Raft.

The Life Raft exhibited by the Monitor Life Saving Raft Company of New York, consisted of India-rubber bags, inclosed in two strong canvas bags of the Circular Tube form, with conical ends. The Raft is buoyant, strong, simple in all its parts, and easily put together. It showed good floating properties, and was manageable when placed in the water. It appears to be a very portable and serviceable machine, and well calculated for saving life in cases of emergency, or for pontooning purposes.

Ice Yacht.

The Ice Boat or Ice Yacht exhibited by Mr. Irving Grimmell, of New Hamburgh, New York, is deserving of commendation. It is rigged like a cutter, runs on three skates, and is reported to attain a speed of about 60 miles an hour, when running with a favorable side wind. This very speedy mode of travelling over the ice, must be attended with considerable risk.

Class 597. Steam Steering Apparatus. Capstans, Windlasses, Chain Stoppers, and Chain Cables.

The exhibits in this class which appeared to be most worthy of notice are: The Steam Steering Apparatus by Mr. Siccles. The Capstans, Windlasses, and Chain Stoppers exhibited by Messrs. Coffin and Woodward, of Boston, U.S., which are simple and effective. The Windlass of the American Ship Windlass Company, of Providence, in which a tongue, actuated by a cam, is substituted for the ordinary pawl and rack. The Chain Cable of Messrs. Prodi of France, which is made without any welds, and the workmanship and material in the Chain Cables of Messrs. Bradle and Company of Philadelphia, appeared to be excellent.

Class 287. Ropes and Cordage.

The Exhibits of Ropes and Cordage are very numerous and very good. Great excellence is apparent in the exhibits of Messrs. Sewell and Day, of Boston, Massachusetts, and the other American manufacturers of these articles. Russia, Italy, and Brazil have numerous exhibits in this class. The Brazilian flax appeared to be very good, but the rope manufactured in that country is rough.

Brazilian and Russian Models.

The Brazilian and the Russian Governments exhibited numerous models of their ships of war, and of their military and dockyard works, which were interesting. One Building of considerable size was completely taken up with the Exhibits of the United States Government Works, amongst which, the model of the mining works at Hell-Gate, for deepening the channel of the Sound, was most interesting and instructive. A considerable quantity of Naval and Military Material was also exhibited here, and samples of the material used in the United States Government works and samples of all the Animal, Vegetable, and Mineral products of the country which were collected in the same building, formed a most complete, comprehensive, and interesting Exhibit, of the wealth, industry, and progress of this remarkable country.

United States Government Works, Naval and Military Material and Comprehensive Exhibit.

I have, &c.

F. H. Rich,
Colonel, Royal Engineers.
Chairman of Group XIX.

To Colonel Sandford,
British Commissioner,
International Exhibition, Philadelphia.

W. H. BARLOW, F.R.S.

MOTORS AND TRANSMITTERS, HYDRAULIC APPARATUS, &c.

Observations on the Motors and Transmitters, Hydraulic Apparatus, &c. examined by Committee B. of Group No. 20. By W. H. Barlow, F.R.S., Vice-President of the Institution of Civil Engineers.

Sir,

In compliance with the request made to me by direction of the Lord President of the Council that I should furnish a report of the objects which came under my attention when acting as one of the judges for "Motors and Transmitters" at the Centennial Exhibition at Philadelphia, I have thought it better to give the observations as recorded in my note book, even at the risk of going more into detail than may be necessary. Preliminary Remarks.

As originally intended, the group named "Motors and Apparatus for the transmission of Power" was made up of classes Nos. 550, 551, 552, 553, 554, and 555; and there was a separate group for "Hydraulic and Pumping Apparatus, pumping, hoisting, &c.," which included the classes Nos. 560, 561, 562, 563, 564, 565, 566, 567, 568. Amalgamation of classes into Group No. 20.

By a subsequent arrangement made by the authorities these two groups were combined into one, which included all the above mentioned classes except 554. Class 554, screw propellors and wheels for propulsion of vessels, removed from Group 20.

To this large group, called No. 20, the following nine judges were appointed:— Nine judges.

Mr. Horatio Allen, South Orange, "Homewood," N.J., President.
M. Emil Brugsch, Egypt, Secretary.
Mr. C. T. Porter, Newark, N.J.
Mr. Jos. Belknap, New York.
Mr. James Moore, Philadelphia.
Mr. Charles E. Emery, 7, Warren Street, New York.
Mr. W. H. Barlow, C.E., F.R.S., London.
Professor Francis Reuleaux, Germany.
M. Nicholas Petroff, Russia.

But it having been found impracticable for each judge to examine so large a number of engines, pumps, and apparatus, involving, as many of them did, considerable complexity of detail, it was decided to divide the group of judges into three committees, A, B, and C, and allot the classes among them, so as to give about an equal amount of work to each. Subdivision of group into three committees.

In this sub-division the classes which came under my more particular observation were those of committee B, namely Nos. 551, 553, 560, 563, and 567. Committee B, Classes 551, 553, 560, 563, and 567.

Class 551 is described in the official catalogue as containing "Water wheels, Water engines, Hydraulic rams, Windmills, &c." Class 551, Water wheels, &c.

There were not, however, any windmills in this class, for although the study of windmills has received much attention in America, and many were exhibited of very clever construction, yet they were all applied to agricultural drainage, and as such were put under the class of "Agricultural appliances." Windmills in another group.

By far the largest proportion of motors in Class 551 were Turbines. Of these about 50 were contributed by the United States and six or eight by Canada. Drawings of Turbines of excellent design were exhibited by Sweden. Turbines.

In fact the only water "Motors" having for their object the production of power on a large scale were turbines. There were a few other water engines for generating power, but only for use by hydrants or otherwise, where small amounts of power are required, as for sewing machines, turning lathes, &c.

From the extensive display of Turbines and the general absence of other large water motors, it would appear that in the United States and Canada the practical advantages of turbines have caused them to supercede water wheels and other water motors.

The form of Turbine most numerously exhibited was that patented by Mr. Leffel, of which two were contributed by the firm of the inventor, Messrs. James Leffel & Co., Springfield, Ohio, and several others by different manufacturers working under his patent. Although not theoretically perfect under all conditions, the very large use made of Mr. Leffel's invention is evidence of its practical utility. Mr. Leffel, Messrs. Jas. Leffel & Co., Springfield, Ohio.

Various forms of Turbine were exhibited, and generally the workmanship was of high quality, with much attention bestowed on the arrangement of working Messrs. Harris & Co., St. John, New Brunswick.

parts. There were few departures from the generally known forms of these engines; that furnished by Messrs. Harris & Co., St. John, New Brunswick, being an exception, and I believe untried as regards its advantages.

O. J. Bollinger, York, Pa.

There were, however, some features of novelty, as, for example, Bollinger's Patent (O. J. Bollinger, York, Pa.), in which the turbine is so arranged that in the event of accident the gates can be set free and close by the pressure of the water. The arrangement made for this object is very simple and effective.

Messrs. E. T. Cope & Sons, West Chester, Pa. Mr. Silas Walton's Turbine, Moorestown, N.J.

Messrs. E. T. Cope & Sons, West Chester, Pa., furnish a Turbine supplied with the means of shutting off the gates in succession. Mr. Silas Walton's Turbine (Moorestown, N. J.) is very skilfully designed for effecting the coincident regulation of the guides and wheel buckets.

Hydrants. Mr. Albert G. Buzby, Philadelphia.

There are a few good contrivances for the application of small amounts of hydraulic power from Hydrants, among which some of the best examples are those of Mr. Albert G. Buzby, Philadelphia, Pa. These are encased water wheels operated by jets of water, an arrangement which is very simple, effective, and compact.

Hydraulic Ram Sentinels, Mr. W. W. Grier, Hulton, Pa.

The Hydraulic Ram Sentinels furnished by Mr. W. W. Grier, Hulton, Pa., are very useful in cases where an hydraulic ram is worked by a stream too small to keep it continuously working. The ram sentinel has the property of putting the ram into action automatically whenever the water accumulates in sufficient quantity to work it.

Hartford Pump Co.

An ingenious arrangement is exhibited by the Hartford Pump Company, in which a windmill is made to work an air pump of such construction as to cause a continuous flow of water from a brook or other supply. It is applicable to those places where wind-power can be obtained on high ground, near to a brook or well at a low level.

Messrs. Poole & Hunt, Baltimore. Messrs. R. D. Wood & Co., Philadelphia.

In concluding class 551, mention should be made of the excellent castings of penstocks and gearing and belt-drums by Messrs. Poole & Hunt, Baltimore, Md., and to the 10-feet belt-drums cast by Messrs. R. D. Wood & Co., of Philadelphia.

Class 553.

"Apparatus for the Transmission of Power, Shafting, Belting, Cables, &c."

Leather Belting.

In this class Leather Belting occupies a prominent position. The extensive use made of belting as a transmittor in the United States and also in Belgium has led to a high degree of excellence in the production of belting in those countries.

The finest examples made in the United States are of leather, some of them 28 inches in width and of excellent quality.

Hair Machine Belting.

Belgium exhibits, besides leather, Hair Machine Belting, a manufacture which is said to be cheaper in cost and greater in strength, and not injuriously affected by water.

Wire Rope.

In degree of importance, however, and from the extensive and varied uses to which it is applied, *wire rope* claims a higher place.

Roebling's Sons, & Co., Trenton, N.J.

Messrs. John A. Roebling's Sons, & Co. are the only exhibitors of wire rope, but their contribution to the Exhibition is of the most striking character as regards its extent, the perfection of workmanship, and the magnitude of some of the samples. Among the cables shown by Messrs. John A. Roebling's Sons, & Co., Trenton, N.J., are those used for the Niagara Railway Bridge (820 feet span), the Cincinnati and Carrington Bridge (1054 feet span), and that designed for the bridge between New York and Brooklyn (1595½ feet span). This latter cable is 15½ inches diameter, and contains 6000 strands of No. 7. cast steel wire, galvanized.

Transmitters—Shafting, Messrs. Poole & Hunt, Baltimore, Messrs. Jones & Laughlin, Pittsburg, Pa.

Another important class of Transmitters is shafting, of which excellent examples are furnished by Messrs. Poole & Hunt, Baltimore, but the most striking manufacture of Shafting is that of Messrs. Jones and Laughlin, Pittsburg, Pa., made by the process of cold rolling. These shafts are first passed through the rolls hot; the scale and oxide is then removed by immersion in acid, after which they are subjected to cold rolling in cast steel rollers.

This process, besides giving a bright finished surface, compresses and condenses the outer portions of the metal to an extent which adds materially to

its strength in resisting tension, compression, and torsion. More than 1,100 feet of this shafting were in daily use in the main building, besides about 1,000 feet in the Agricultural Hall.

Coupling Round Shafts, Mr. John Charlton, Philadelphia.

Of the methods of Coupling Round Shafts together that of Mr. John Charlton, Philadelphia, Pa., is well deserving of notice. Simple and effective in construction, it is complete in its action, whether the shafts connected by it are of the same or of different diameters.

Ewart's detachable Driving Chains.

Ewart's detachable Driving Chains, Ewart Manufacturing Co., New York, form an efficient means of transmitting power. They are formed of cast malleable iron links, any of which can be detached or others added so as to shorten or lengthen the chain. The links work on to cogs on the driving wheels, and the working is smooth and even.

Self-oiling Bearings, Mr. Dufrene, France.

Among the apparatus connected with shafting the Self-oiling Bearings of M. Dufrene, of France, are exhibited. The oil is placed in a receptacle formed in the lower part of the bearing, and supplied to the moving part by capillary attraction through cotton wick. By this means the oil is supplied quite clean, all foreign matter being left in the receptacle below. The working of these bearings is said to be very satisfactory.

Class 563.

Hydraulic Jacks, Presses, Elevators, Lifts, Meters and Cranes.

Elevators.

The most numerous objects in this class are Elevators. In those applied to passenger purposes, one main object of attention is directed to the provisions for safety in the event of the supporting rope or chain breaking.

Messrs. Otis, Bros., & Co., New York. Messrs. Andrews.

Messrs. Otis, Brothers, & Co., New York, exhibit a well-known form of Elevator with safety rack. Messrs. Andrews secure safety by the friction of wedges against wooden uprights—an arrangement which is said to work well.

Mr. Joseph Goldmark, New York.

Mr. Joseph Goldmark, New York, exhibits a novel method of attaining the same object. The lifting is effected by a strong flat linked endless chain, working in a groove, and so arranged that the chain can only move in the direction of its length. Thus, if the suspending part of the chain breaks, the lower part below the carriage, being unable to move laterally in its groove, becomes a rigid support to the carriage.

It is to be observed that in the elevators used in some of the principal hotels safety is secured by employing several supporting ropes operating at the same time, any one of which is capable of bearing the entire weight. Some of these elevators not only worked admirably, but were rendered attractive by the elegance of their internal fittings, and it is much to be regretted that they were not exhibited at the Centennial.

Steam Hydraulic Cotton Press, Mr. John F. Taylor, Charleston, S.C.

The largest and most imposing-looking machine in Class 563 was the Steam Hydraulic Cotton Press of Mr. John F. Taylor of Charleston, S.C. It is constructed with two steam pressure cylinders 22 inches diameter and 4 ft. 10 in. stroke, and worked by two steam cylinders on the compound principle 56 inches diameter and 8 feet strike. This powerful machine is very efficient and expeditious in its operation and economical in consumption of fuel. It is stated to be capable of pressing 930 bales in 10 hours.

Compound Hydraulic Press, Messrs. Bolen, Crane, & Co., Newark, N.J.

An extremely ingenious Compound Hydraulic Press is exhibited by Messrs. Bolen, Crane, & Co., of Newark, N.J. It is a machine of great power, obtained by the accumulated action of several divisions of the press acting on one plunger, so that with a comparatively low pressure of water a very large power of pressing can be given. The construction is very simple, and the mode of obtaining the action is new, but the range of distance through which the plunger can move is limited to less than that of ordinary hydraulic presses.

M. Morane, jr., Paris.

M. Morane, jr., of Paris, exhibits a Press of excellent construction for extracting oil from stearine. This machine, which is used for candle manufacture, is most carefully made, well adapted to its purpose, and of excellent workmanship.

Mr. T. A. Weston Yale Lock Manufacturing Co., Stamford, Conn.

There are several clever contrivances invented by Mr. T. A. Weston, and exhibited by the Yale Lock Manufacturing Co., Stamford, Conn. They involve novel applications of mechanical action—first, in the accumulated action of frictional surfaces; second, in the means of applying friction clutches through the driving shaft; and third, an arrangement whereby the power required to lift a weight can be varied while the weight is suspended and in motion.

Gunpowder Pile Driving Machine, Philadelphia.

The Gunpowder Pile Driving Machine, exhibited by the Gunpowder Pile Driver Company of Philadelphia, is a well-made example of this ingenious and effective class of engine.

M. J. Chrètien, Paris.

M. J. Chrètien, of Paris, furnishes a model of a form of Steam Crane extensively used in France. The steam cylinder is in the jib, and operates by lengthening and shortening the jib, and so obtaining the lifting power.

Messrs. Appleby Bros., London.

Appleby Brothers, of London, exhibit Steam Cranes of excellent and substantial workmanship.

There are many other articles in this class, such as Hand Hoists, Hod Hoists, Double Screw-Jacks, Quadruple Screw Presses, &c., but they do not contain features of construction calling for special remark.

Class 560.

"Pumps and Apparatus for Lifting and Moving Fluids."

Rotary Pumps, Direct Acting Steam Pumps.

This class contains a large number of articles, and a great variety of constructions. The most prominent, both in number of exhibits and in power as machines, were Rotary Pumps and Direct Acting Steam Pumps. Rotary pumps were exhibited by the United States, Great Britain, Canada, France, and Belgium. The largest of these machines in actual operation in the building was that of Messrs. Heold, Sisco, & Co., Baldwinsville, N.Y., which delivered a full bore stream of 12 ins. diameter. John and Henry Gwynne, Hammersmith Iron Works, London, exhibited a beautiful Model of their Rotary Pumps which have been erected at Codigoro, near Ferrara, Italy; they are of immense size, estimated to be capable of raising 2,000 tons of water per minute from 10 to 12 feet high. M. Léon Moreau, of Brussels, exhibits a Model Pump in which the principle of close contact is practically maintained throughout the rotation. This is an excellent machine for perfectly clean water, but apparently liable to derangement by any gritty particles.

Messrs. Heold, Sisco, & Co., Baldwinsville, N.Y.

Messrs. John and Henry Gwynne, Hammersmith Iron Works, London.

M. Léon Moreau, Brussels.

Direct Acting Steam Pumps.

With one exception all the Direct Acting Steam Pumps which came under my observation were produced by makers in the United States. They are generally of very good workmanship, with careful consideration given to the details, especially as to the steam cushions for the main pistons, and the facilities for obtaining access to the valves and replacing them when required. In several of these pumps the valves were themselves moved by steam, without the intervention of tappets, of which construction those by Messrs. Edward Dart and Co., New York, and Mr. Jonathan Pickering, Globe Works, Stockton-on-Tees, are examples. In the pump exhibited by the Norwalk Ironworks Company, South Norwalk, Conn., the action of one valve governs the whole movement. The Niagara Works, Brooklyn, N.Y., in addition to their direct action pumps, exhibit a good crank pumping engine, with a simple screw coupling to connect it with its pump, and so arranged that when disconnected from the pump the engine is available for any other work. Crane Bros.' Manufacturing Co., Chicago, Ill., exhibit large pumps, with 18 in. diameter of barrel. Knowles' Steam Pump Works, New York, produce a fine display of pumps of large size, blowing engine, heavy lift mine pumps, &c.

Messrs. Edward Dart & Co., New York.

Mr. Jonathan Pickering, Stockton-on-Tees.

Norwalk Ironworks Co., Conn.

Niagara Works, Brooklyn, N.Y.

Crane Bros.' Manufacturing Co., Chicago, Ill.

Knowles' Steam Pump Works, New York.

Pulsometer Pumps.

There are six or more exhibits of Pulsometer Pumps, all by American makers. The attractive feature of these steam pumps consists in the simplicity of construction, the absence of pistons, and the very small amount of working parts. Pulsometer Steam Pumps are cheap in construction and in repairs, but not economical in the steam required to work them, in consequence of loss by condensation. Nevertheless there are many circumstances and conditions under which the employment of pulsometer pumps would be of great utility.

Pulsometer Steam Pumps.

Vacuum Engines.

The Vacuum Engines, of which there are several, are for the most part intended to be worked, or are capable of being worked, by the exhaust steam of engines employed for other purposes. Under these conditions the work obtained from them is so much waste power utilized. In both pulsometer and vacuum pumping engines the tendency to loss by condensation is diminished by lining the vessels with wood or non-conducting paint. These pumps do not choke by sand or other small particles of solid matter. The Vacuum Pump of Messrs. Nye, Gourlay, & Co., Chicago, Ill., is favorably reported upon by the engineer of the United States navy.

Messrs. Nye, Gourlay, & Co., Chicago.

The pump exhibited by the New York Hydraulic Drainage Company differs from the others in having three cylinders or steam vessels instead of two, and the valves, instead of being automatic, are worked by a small water wheel, operated by the water delivered from the pump. Two forms of propeller pumps are exhibited in the United States Department. One by the Hydrostatic and Hydraulic Company consists of a series of propellers on one shaft, contained in a straight vertical cylinder. The other has two shafts working two series of propellers, the propellers on one shaft being opposite the spaces between the propellers in the other. In this pump the cylinder is bent from side to side to suit the position of the propellers, and the shafts revolve in opposite directions. In the first-named pump the upward flow has the advantage of a straight cylinder, but the action of the propellers imparts a rotary movement to the water. In the other the tendency to a rotary movement in the water is prevented by causing the two shafts to revolve in opposite directions, but the upward flow of water has to pass through the several bends of the cylinder. The relative merits of these two pumps can only be ascertained by actual test; but one remark is common to both, namely, that with sufficient power water can be raised to very great heights. The straight cylinder pump is stated to have raised water 278 feet high.

New York Hydrostatic Drainage Co.

Hydrostatic & Hydraulic Co.

Messrs. Sluthour & Mintzer, Philadelphia, Pa., exhibit an Oscillating Bilge Pump of very simple construction, and Messrs. Wilson, Clarke, & Co., Yarmouth, Nova Scotia, have a good sample of pump for the same purpose. There are several examples of Excavator Pumps, some adapted to sewage, and provided with arrangements to render the operation odourless. Matthewman & Johnson, New Haven, Conn., and Mr. Isaac Hyneman, Philadelphia, Pa., and the Odourless Excavating Company exhibit good examples. These pumps are capable of moving fluids charged with a large amount of solid matter, such as small stones, broken bricks, &c.

Oscillating Bilge Pumps, Messrs. Sluthour & Mintzer, Philadelphia.

Messrs. Wilson, Clarke, & Co., Yarmouth, N.S.

Excavator Pumps. Matthewman & Johnson, New Haven, Conn. Mr. Isaac Hyneman, Philadelphia. Odourless Excavating Co.

Hand pumps remarkable for simplicity and cheapness are exhibited by the United States and Canada. The double acting Two Valve Pump of Mr. W. H. Harrison, Philadelphia, Pa., is an original idea, but its practical advantages require testing. Fine examples of Fan Blowers are exhibited by Mr. B. F. Sturtevant, Boston, Mass. In one of them the fan is 67 inches diameter. The workmanship is excellent, and the details carefully considered.

Hand Pumps. Mr. W. H. Harrison, Philadelphia.

Fan Blowers. Mr. B. F. Sturtevant, Boston, Mass.

There are two examples of Hydraulic Rams. One by Messrs. A. Gawthrop & Son, Wilmington, Del., is a Double Ram, so arranged as to enable a supply of good water to be raised by a stream of any other water which may be available in sufficient quantity. The other hydraulic ram, together with some pumps, are exhibited by M. T. C. da Costa, of Brazil, and are interesting as exhibiting a new branch of industry in that country. In this class is also a Tank for the storing of inflammable oil—a very ingenious construction invented by Mr. Stephen Webster, St. Catherines, Ontario. It is so arranged that the oil is always surrounded by water. The difference in the specific gravity of oil and of water enables the oil to be drawn from the upper surface of the water, while it can be filled again by a tube, which, by increasing the column, causes the oil to displace the water. The tank can be sunk in the ground out of danger both of fire and lightning. Two Water Extractors of good construction are exhibited by the American makers, Mr. W. P. Uhlinger and Mr. H. Chapman, both of Philadelphia, Pa.

Hydraulic Rams. Messrs. A. Gawthrop & Son, Wilmington, Del. M. T. C. da Costa, Brazil.

Tanks. Mr. Stephen Webster, St. Catherines, Ont.

Water Extractors. Mr. W. P. Uhlinger, Mr. H. Chapman, Philadelphia.

Besides the numerous forms of Pumps and Hydraulic Apparatus mentioned there are fine displays of pumps adapted to various purposes, hydraulic rams, and many other hydraulic engines. Among the imposing displays of this character may be mentioned those of—

Messrs. Rumsey & Co. (Limited),
Gould's Manufacturing Co., both of Seneca Falls, N.Y.,
And Messrs. W. and B. Douglas, Middletown, Conn.

Messrs. Rumsey & Co. Gould's Manufacturing Co., Messrs. W. & B. Douglas.

The only other objects which came under the special attention of Committee B were the Diving Dresses (Class 567). There were but two exhibits, one from the United States, the other from Great Britain. The exhibitors were Mr. J. W. Bolles, Baltimore, Ma., and Messrs. Siebe and Gorman, of London. Both were well made and well fitted in their appliances.

Diving Dresses. Mr. J. W. Bolles, Baltimore, Messrs. Siebe & Gorman, London.

Speaking not only of those classes which fell more immediately under the observation of the judges in Committee B, but also from general observation of other classes in the group, one cannot fail to notice the great fertility of

Fertility of American invention.

invention displayed in America, and the excellent workmanship obtained by the joint effect of their tools, machinery, and skilled workmen. Compared with English machinery, that of America appears somewhat lighter, and although not deficient in strength, is perhaps not so well adapted to those cases where great steadiness of action and freedom from vibration is required; but ingenuity of device and fertility of mechanical resource is everywhere observable. The aim at improvement takes two different directions: one being that of obtaining simplicity and cheapness of construction, putting the cost of working as of secondary importance. The other being the endeavour to obtain high perfection in the details and great economy of working, treating the cost of construction as of less importance. The one in fact being aimed at cases where engines and machinery are employed for temporary purposes, the other directed to those cases where continuous working is the object.

Aim at improvement in two different directions.

The production of a given result by the cumulative effect of a repetition of similar mechanical actions is a peculiarity frequently observable: as, for example, in Bolen, Crane, & Co.'s Compound Hydraulic Press, where the pressure is obtained by the accumulated action of a series of similar discs; in Weston's Brake, in which great friction is obtained in like manner; the Propeller Pumps, which attain their result by the cumulative action of a series of similar propellers; and the Injector of Messrs. Nathan & Dreyfus, New York, which is in effect the cumulative action of several injectors.

Bolen, Crane, & Co.'s Compound Hydraulic Press.

Weston's Brake.

Propeller Pumps.

Nathan & Dreyfus' Injector.

Concluding remarks.

As a whole the machinery hall gave me a high opinion of the mechanical skill of the Americans. There is great inventive power, and a ready and fearless adaptation of the means to the end sought. In considering what is displayed in the numerous and varied contrivances, it has to be borne in mind, that many of them come from distant parts of the country, and have to be contrived out of such materials and with such means as may be at hand. But in the machines and apparatus from the larger establishments and more favourable localities, the workmanship is admirable, and every working part down to the smallest detail bears evidence of thought and study.

W. H. Barlow.

Colonel Herbert B. Sandford, R.A.,
British Executive Commissioner.

DR. ANDERSON.

MACHINES AND TOOLS FOR WORKING METALS, WOOD, AND STONE.

Report on Machines and Tools for working Metal, Wood and Stone at the Philadelphia Exhibition. By John Anderson, LL.D., C.E.

This report chiefly refers to machine tools. The following statement shows the various classes that were combined in Group XXI. Group XXI.

Clauses 510, 511, 514, 515, 516.

1. Class 510.—Planing, sawing, veneering, grooving, mortising, tonguing, cutting, moulding, stamping, carving, and cask-making machines, &c.; cork-cutting machines.
2. Class 511.—Direct-acting steam sawing machines, with gang saws.
3. Class 514.—Steam, trip, and other hammers, with specimens of work, anvils, forges.
4. Class 515.—Planing, drilling, slotting, turning, shaping, punching, stamping, and cutting machines. Wheel cutting and dividing machines.
5. Emery wheels and mountings.
6. Drills, taps, gauges, dies, &c.
7. Class 516.—Stone-sawing and planing machines; machines for dressing, shaping, and polishing; sand blasts; Tilghman's machines; glass-grinding machines, &c.

Awards were made by individual judges, who reported on the merits in detail. Those reports might be concurred in, or dissented from by the other judges, in the awards of Group XXI. the concurrence was unanimous throughout. System of Awards.

The following were the names of the judges in Group XXI., viz.:

American. American Judges.

George H. Blelock -	- Springfield, Mass.
W. F. Durfee -	- Wisconsin (at 56, Broadway, N.Y.)
Prof. John A. Anderson	- President Kansas State Agricultural College, Manhattan, Kansas.

Foreign. Foreign Judges.

Mr. John Anderson, LL.D., C.E.	- Great Britain.
M. le Commandant F. Perrier -	- France.
Mr. C. A. Angstrom - -	- Sweden.
Mr. Auguste Gobert (fils) - -	- Belgium.
Mr. Felix Reifer - -	- Austria.

At the first meeting of the group, Dr. Anderson was unanimously elected to be chairman and M. Aug. Gobert, secretary. Chairman and Secretary.

It is the writer's impression that the work is done more impartially by judges than by jurors.

So far as relates to Group XXI., the whole of the arrangements of the United States Centennial Commission, for the International Exhibition, Philadelphia, 1876, were admirably conducted throughout, and reflected the utmost credit upon all concerned. Arrangements of Centennial Commission admirable.

The Exhibition of machinery at Philadelphia in 1876 was a great event in the history of applied mechanics; as a whole it was a magnificent display of refined mechanism, rich in new ideas, full of fresh instruction, and most encouraging in promise of the future. Past inventions were presented under new and unlooked for arrangements, the old ideas leading to fresh devices. It was most suggestive in presenting new forms to materials, new constructions containing original combinations of matter, in alliance with force, or Preliminary Remarks.

mechanical energy. Novel applications of ingenious mechanism to useful purposes in art and manufacture, all conducive to the saving of labour, or the economy of materials, and all striving to attain excellence in production, combined with good proportion in strength, harmony, and beauty in outline.

Display of Machine Tools.

The display of machinery classed under the name of "machine tools" was perhaps the most remarkable feature of all. As a collection of tools it has never been equalled either for quantity, or for quality, or for fitness. The grand and united effect which it produced, was no mere result of repetition according to well known forms of construction, but was due to abounding novelty, originality, and progress. This department of the Exhibition had a strongly marked American character, and can hardly be regarded as an international competition. Other civilized countries it is true took part therein, but the aggregate did not equal one fourth of the articles exhibited from the United States. There was also marked evidence of patriotic spirit in the prodigious efforts made by individual citizens and firms to sustain worthily the mechanical reputation of their country. The excellence and originality of the machine tools displayed by many firms, impressed a stranger immensely, and however much he may have seen of former International Exhibitions on the grand scale, these impressions survive.

Improvements in design, materials and workmanship.

It will of course be readily understood that the majority of such articles exhibited by all countries, America included, were not distinguished for originality or even for novelty, but rather as in former national gatherings for their good qualities in respect to design, materials and workmanship, in regard to each, there is a marked improvement at each recurring exhibition. The greatest change is observable in the products of the nations that were formerly the least advanced. This equalizing tendency of exhibitions has to be taken into account in estimating their active force as agents for advancing civilization.

Comparative Representation of United States and Europe.

Neither England, France, nor Germany were even approximately represented at Philadelphia, any more than were the United States at London, Paris, or Vienna. The machinery sent from the whole of Europe was so limited in quantity, and with a few grand exceptions so commonplace in character, that no real comparison could be made, nor was it attempted. Any genuine rivalry that existed was among the different states and firms of America, and was intense to a degree rarely seen on this side of the Atlantic. Even the old rivalry of Lancashire and Saxony so intensely displayed at former exhibitions, was hushed in the presence of such an array of tools that neither England nor Germany were for the time prepared to meet. The Paris Exhibition of 1878 will give the European nations an opportunity of asserting their proper place before the world if they choose to vindicate it. Great Britain especially will have to consider the situation. In 1862 we made a most decided impression, the effect of which is still perceptible; but if we do not make a greater effort for Paris than we have done for Vienna and Philadelphia, our reputation may suffer and be transferred to others. Our display of machine tools at Vienna contained so little of freshness, and was of so stereotyped a character, as to give encouragement to some of our foreign competitors to express openly in their printed reports, that we are losing our former leadership and that it is passing to the Americans. Our display at Philadelphia, although smaller in quantity was considerably richer in originality and in everything that marks thought and progress. But even with it all, if we are to be judged by comparison with the Americans in 1876, as doubtless we shall be in the minds of other nations and in their official reports, it is more than probable that the effect will be to confirm their previous statement. Even among ourselves at Philadelphia, it was impossible to resist the conclusion that a great change is going on in the relative position of different countries at these machinery gatherings, whether we believe it or not, or whatever may be the explanation.

Testing for mathematical accuracy.

One remarkable circumstance in connexion with the Philadelphian Exhibition should be noted. Machine tools were there subjected to a course of rigid testing in order to ascertain their mathematical accuracy. This had not been done at any previous exhibition, but was strongly recommended in some of the European official reports, as in those from Vienna in 1873, more especially in the official report of Great Britain.

American familiarity with reports of previous Exhibitions.

It was strange to observe how very familiar the American exhibitors were with those reports, and to find so few of the Europeans who had read or even heard of them. Throwing away such a chance is not a small matter; it is vitally important, it denotes an active intelligence which counts for much in the commercial competition in machinery that is stored up for the nations at no distant date.

Necessity for mathematical accuracy in Machine Tools.

Machine tools, with their collateral adjuncts, when considered as the agency by which other kinds of machinery are to be produced, lose a great part of their value when deficient in mathematical accuracy. Unless true circles, straight lines, parallelism, and absolute truth, inherently exist in themselves, they are not capable of imparting those conditions to the materials upon which they operate.

Evil results of inaccuracy.

Inaccuracy in tools lowers the quality of their produce, and, indirectly, increases the cost of production enormously. When tools are thus considered as agents to transfer their own character whether good or bad, the importance of rigid accuracy is self-evident, and exhibitors at future gatherings should be prepared. The circumstance that this class of machinery when considered as the agency for transmitting quality and precision in the production of all other kinds of machinery, from watches to steam engines, has consequently an importance which will not be overlooked by the intelligent mind, in estimating the economic forces that are now in operation, not only in England and America, but all over the civilized world. There is no better criterion of a country's civilization than the condition of its tools; the two go hand in hand, and are the reflex of each other. Even with the simple tools of past ages, in combination with skill and craft and the intellectual force of the human mind, we are indebted for every thing which we see on earth that affords evidence of material advancement. Still more, in the automatic machines of modern times, tools have assumed a far higher relative position, because in them, the mental faculties, the skill, and craft are permanently embodied, and in addition, many of them are qualified to transmit their virtues or vices, without assistance.

Condition of Tools a criterion of a Country's civilization.

Official Circular Letter with reference to test.

At the Centennial Exhibition, with a view of testing machine tools for accuracy, an official circular letter was sent to all tool exhibitors, giving them the opportunity, but leaving it to their own option, of which the following is a copy:—

"Sir, At a meeting of the members of Group XXI., held May 27, it was resolved—'That every exhibitor of machines included in Group XXI. be 'invited to test his exhibit for mathematical accuracy of construction, and 'that the method of that test be left to the option of the exhibitor.'

"You are therefore respectfully requested to inform this committee at once whether or not you are willing to test your machines in the presence of the Committee, with the view of showing the degree of perfection you have attained."

Unanimous favourable response from American Exhibitors.

As if by concert, almost every American firm of high standing volunteered, but, with the exception of Canada and one French firm, there was no response from any other nation. When it came to the actual testing, it was evident that the Americans had anticipated such an ordeal, and had even prepared the instruments by means of which accurate results could be obtained, in fact, the very instruments by which they had verified their tools before going to the Exhibition. Still further, some of the American firms strongly urged the testing of accuracy in their tool productions, combined with the element of time in execution, one firm for example, offering one of their special automatic tools, to finish a locomotive cylinder in three hours and a half, that is to say, to bore the cylinder twice through, to recess the two ends of the bore, and to turn and face the two flanges. Their offer was accepted, and a rough cylinder from the foundry was obtained from the Baldwin Locomotive Works, and the several operations were satisfactorily performed within a few minutes of the time specified. The attendant workman was from Lancashire, and unaccustomed to the work, and besides, the casting was of exceptionally hard and obdurate metal, which tried the cutting instruments severely.

Time test.

Test for Drilling Machines.

Drilling machines were tested, by fixing a long scriber to the spindle, passing it round the outside of the table, with the spindle and table in various and extreme positions. A measuring instrument intervened between the scriber and the table surfaced planes, it consisted of a graduated incline, with a vernier,

by means of which any error could be read off to the thousandth part of an inch. The accuracy of the greater number of the machines was marvellous, and in many, not the smallest error could be detected. Suitable devices were employed in testing lathes and other machines; the general result went to show a degree of precision which took the judges from all nations by surprise. As a fact in practical mechanics, this testing cannot be made too widely known, nor overrated in its importance.

Magnitude of display.

That the display of machine tools at Philadelphia was a great success, was admitted by all who were capable of forming an opinion. The collection however was so vast that it is scarcely possible in a brief report, to give such an outline as would enable those who have not examined it, any idea of its magnitude, variety, or excellence.

Space occupied by Machinery Hall and Annexes.

The Machinery Hall proper covered an area of about 14 acres. It was 1,400 feet long by 360 feet wide, but this vast space conveys no adequate notion of the collection as a whole. There were besides so many annexes for various special classes of machines, that the entire display of refined mechanism occupied nearly 20 acres. Of that vast space fully more than the half was filled with machine tools from nearly every civilized country. The greater proportion of the machines in the Machinery Hall were driven by a pair of Corliss engines, each of 700 horse power nominal. The two engines were coupled and transmitted their united power through one spur fly-wheel. As respects the mechanism by which the 1,400 horse power, was transmitted over the 14 acres of machinery, the construction was simply perfect. Notwithstanding the high speeds, the toothed wheel gear—all metal to metal—worked with scarcely any noise or tremor. Such high conditions of excellence were no chance results, nor obtained by any wood-cog expedients. Throughout the entire plant, the spur fly-wheel included, the teeth had been all shaped to the precise lines prescribed by scientific theory. The spur gear of the fly-wheel gave motion to a shaft that crossed the building transversely, and from proper points on this shaft, through bevilled gear, other shafts passed right and left, from which, by means of leather bands, 30 inches in width, the motion was conveyed by numerous overhead lines of shafting, which gave motion to the machinery arranged all over the hall. In driving the machine tools, it was generally necessary to have intermediate counter-shafting, and in many instances, and more especially for wood-working machinery, duplicate and triplicate counter-shafts had to be employed, in order to reach the required velocity. The whole combination of intermediate mechanism, for the effectual transmission of power over so great an area, and to drive so many machines so various in their requirements, was truly admirable.

Corliss Engine.

System of Shafting.

Intermediate Counter-Shafting.

Before referring to the American machine tools, which for obvious reasons were the most interesting to Europeans, from their many points of difference from our own, some remarks on the relative position and progress of the other countries as shewn at Philadelphia, may be of interest. The machine tools from Europe however, were comparatively few in number, and as a rule possessing little novelty requiring special mention.

Paucity of novelty in European Machine Tools.

Great Britain and Canada.

Comparison of Canadian with British Exhibits.

Great Britain and Canada occupied the best position in the Machinery Hall. If we were to take the Canadian Exhibition in connexion with the British and consider them as one, in the same manner as was done in the United German Empire, then, indeed, the extent was greater than all the rest of the world, exclusive of the United States. England had seven distinct exhibitors of machine tools, four of the number having but one machine. This paucity of tools, from the nation which has hitherto taken the lead, both in devising and making, is a painful circumstance to mention, but the truth must be told. Fortunately, Canada made a good display in tools, which to some extent veiled over the shortcomings of the mother country. There were thirty exhibitors of machine tools from Canada, and no other country produced a stronger feeling of surprise by the extent and excellence of the general machinery exhibit, than did that colony.

Extent and Excellence of Canadian Exhibition.

All were prepared to see a brilliant display by the United States, and none of the European nations did so much as might have been expected. The Canadian Exhibition, when considered in relation to the number of its

population and to the comparatively short period that has elapsed since she gave herself resolutely to engineering, was truly noble, Although one of the youngest competing nations in machine tools, yet it contained many admirable specimens which would have done honour to any country.

Canada was fortunate at Philadelphia in having her position assigned at the chief entrance to the Machinery Hall, where the majority of visitors had to pass through the space containing her products. Position assigned to Canada.

For some unexplained reason, no collection was more freely commented upon, or had any apparent fault pointed out so repeatedly, as the young competitor, and it may be safely added, that no nation has derived more benefit from the practical teaching of that great educator, the Centennial Exhibition, than did that country. Canadian machinery, has a character of its own; unlike some of the continental nations, theory has not gone before practice, from the circumstance that her engineering knowledge and experience have not reached the foundry and smithy through the technological college or the class-room, but rather through the teachings and promptings of necessity, and from contact with the mother country and her immediate neighbours. Hence it is, that the style is a mixture of English and American, but more of the latter, than the former, the machine tools for metal resembling the English, those for wood being rather American, but with a considerable trace of original thinking interspersed throughout all. Besides, there is a freshness and youthful vigour manifested both in design and execution that foretell the future giant. Special Character of her Exhibits.

By far the best machine tool exhibit from Great Britain came from Lancashire. It was a magnificent exhibition of steam hammers, by B. and S. Massey, of Manchester, which did much to uphold the national character in many respects. The appearance of those hammers as a group was truly noble, and throughout they possessed all the attributes and virtues that determine high quality, and were considered by the Americans as a worthy offering from the birthplace of the Nasmyth steam hammer. Steam Hammers, Messrs. B. & S. Massey of Manchester.

These hammers were of many different sizes, from the smallest class, giving 300 blows per minute, up to 5 ton hammers of massive grandeur. They were equally varied in the manner of construction, and were severally adapted in their mode of action to the numerous purposes of the metal manufacture, in its several branches and trades. Almost the whole of that extensive plant of hammers were arranged for double acting, and adapted to strike either a light or a heavy blow, quickly or slowly, a dead blow or an elastic blow, at the will of the operator. This firm was fortunate in having an attendant who could work the hammers to advantage. This is a great point at an exhibition, but too frequently overlooked. In this respect, England is always conspicuous, notably at Vienna, but never more so than at the Centennial. Such fearless manipulation makes a decided impression both on judges and visitors, which goes to the credit account of the nation, and affords ample evidence that there is no sham about such tools, but that they are meant for real business, and fully equal to their work.

Although Manchester may be considered as the cradle of machine tools, still, at the great Centennial gathering there was no large exhibit of lathes, planing, and other machines for working metal, to enable England to take her proper place beside the great rival American firms, and to show that there is yet life in the old country, but it was the day of small things. An interesting plant of machinery in connexion with calico or other printing, was submitted by Mr. Gadd of Manchester. This plant contained a fair specimen of a small lathe as an adjunct to a particularly interesting machine tool, which was employed in preparing the pattern upon the surface of the printing rollers. This tool attracted a considerable amount of attention, from the admirable manner in which it performed its novel function of transferring a pattern from a copy made inherent in the mechanism, to the surface of the printing roller, yet, without having recourse to the usual system, by engraving, and more especially for the novelty of the methods by which it is accomplished, and for the combination of two distinct principles of action in one machine, which could be varied indefinitely. Calico Printing Machinery, Mr. Gadd of Manchester.

The machine was of the lathe order of tools, mounted with two sets of appendages, one for transferring by milling, the other by impact. In the first method, the transfer is effected by the pressure of the milling tool, a circular piece of steel, engraven upon its edge, rolling in contact and under the

automatic guidance of the machine. In the other method, by impact, the required pattern is engraven upon the end of a piece of steel, afterwards suitably tempered, which is used by the machine as a sort of stamp under the control of the apparatus, transferring the pattern most efficiently, and at a small cost.

Machines for Screwing and Tapping, Messrs. Joshua Heap & Co., Oldham.

The firm of Joshua Heap and Co. from Oldham, exhibited an exceedingly neat and most admirable plant of small machines for various screwing and tapping operations, which were not without a slight trace of originality, in a speciality that might be considered as exhausted, for there will always remain some little secret hidden away in the archives of nature, to be picked up by the earnest and qualified seeker. This firm have shown that even the common screwing tap may be improved still further. By a combination of new devices, each a trifle in itself, these screwing machines produce articles at a rate which would have been deemed impossible a few years ago. As specimens of good sound construction, this plant deserves to be commended, and although small, it affords good evidence of what this firm can accomplish.

Shearing Machine, Messrs. Beesley & Sons, Barrow-in-Furness.

Messrs. Beesley and Sons, of Barrow-in-Furness, Lancashire, exhibited a shearing machine of their own designing, with some novel features in its mechanism, the whole of the gearing was under the floor, with three distinct and simultaneous points of shearing action, to suit angles and other shapes. As a specimen of machine construction, however, it required maturing in its proportions of strength, resilience being excessive.

Textile Machinery. Messrs. Greenwood & Batley's Exhibits, Machine for Forging Bolts.

There were several large displays of textile machinery from Leeds, all most creditable to England. Two of the above firms each sent one machine in Group XXI. Greenwood and Batley submitted a novel machine for forging bolts with several points of originality that commanded some attention. It was on the principle of the French coining press, by Deny of Paris, but carried out with bevilled friction surfaces. Unfortunately it was not set in operation, a furnace being inadmissible in the Machinery Hall. This firm had several other machines exceedingly clever, two decidedly original, which drew forth great admiration from all visitors, who examined them in action, including some of the inventors and mechanicians of America, but those machines do not come under "machine tools."

Messrs. Fairbairn, Kennedy, & Naylor, Machinery for Working Jute.

An imposing display of machinery for working jute and one machine tool, by the well known Leeds firm, Messrs. Fairbairn, Kennedy, and Naylor. The entire plant was characterised by great solidity and simplicity combined with efficiency. The machine tool submitted by this firm, was a quadruple drilling or boring machine of most massive construction, intended chiefly for the purposes of the locomotive engineer. Each of the four drills could be used singly or simultaneously. One peculiarity, consisted in giving feed motion, by the upward movement of the work table, thus avoiding the tendency of the spindle to drop, as it passes through the article under operation.

Stone Dressing Machine, Mr. J. E. Holmes, Mr. Hugh Shearer, London.

A large stone dressing machine was shown in daily operation, the invention of Mr. J. E. Holmes, of London, but exhibited by Mr. H. Shearer, of London. Its principle of action closely resembles that of the stonemason with his chisel and mallet. The rough stones are laid upon a travelling bed, similar to that of a machine for planing metal. The bed moves slowly, at the rate of four or five feet per minute, and returns at the same pace, and receives the cutting action both ways. The cutters consist of a double row of chisels fixed into a transverse holder, to which is imparted a small amount of undulatory motion, to give the row of cutters the effect of the chisel and mallet. At the end of each pass, the cutter holder alters its relative position automatically in order to bring the proper set of cutters into play. A few passes of the stone are sufficient to give a smooth surface, fully equal to the best hand-work. In construction the machine is massive and well put together, and from the extent of its bearing surfaces, is likely to be durable.

Coal Cutting Machines, Mr. J. E. Holmes.

Another machine invented by Mr. Holmes, stood beside the stone dresser. Its purpose was for cutting coal in the mine. The instrument was a coarse saw, to which was imparted a wriggling motion. The saw teeth were inserted into the blade about an inch apart, and from the peculiar movement given to the saw, the teeth would act as cutters.

This saw projects about four feet from the apparatus, and is provided with the necessary self-acting motions for movement in any required direction.

From the comparative thinness of a saw the groove formed is proportionally narrow, thus reducing the amount of dust, which is so far an advantage; but being as yet untried as a practical miner its fitness for clearing a way through the dust remains to be ascertained. As a tool, it seemed to be the object of much attention by the engineers of all countries.

Messrs. Baird, Glasgow.

Another machine for cutting coal was submitted by Messrs. Baird, of Glasgow, which had been at mining work for several years and was reported to be most efficient and practical. It was shown in action, but more to show its paces than as a coal cutter. Still it commanded much attention and admiration. In this machine the cutters are fixed upon the outside of an endless pitch chain that works round a pulley upon the end of a thin iron arm projecting about four feet from the chief mechanism. This arm and its appendages have automatic motions to guide them in the required directions, and thereby to chisel out a groove about two and a half inches in width, the chips being carried outwards by the movement of the cutters.

Painting Machine, Mr. Roberts, Bootle.

An interesting small machine, for painting articles in repetition, was exhibited by Mr. Roberts, of Bootle, near Liverpool. The laths of Venetian blinds, hoop iron, ballusters, bars, were passed through rapidly, and painted most efficiently, the machine being self-acting. As a machine it was but a trifle, still, in the dearth of English tools at the Centennial, it had to pass muster.

Canadian Machinery.

The classes of machinery exhibited by Canada embraced almost every branch. Of motors there was great profusion, both for water and steam, and upwards of 20 steam and other pumps on the latest systems of construction.

Messrs. McKechnie & Bertram, Dundas.

In the finer department of machine tools Canada came out nobly, and in some measure made up for the brief list from the mother country. One firm in particular, McKechnie and Bertram, of Dundas, made a fine exhibit both for metal and wood. Coming from Canada it took all nations by surprise. The machine tools for metal were mostly after the English style, inclining rather to Leeds than to Manchester. Perhaps their most perfect tool was a large slotting machine of fine proportions, most consistently carried out in all the details, with every part in good keeping with the others, which is a rare virtue and seldom manifested by those makers who can only imitate.

Machine Tools for Metal.

Radial Drilling Machine.

Their most conspicuous tool, however, was a radial drilling machine, of real exterior beauty, arranged in such a manner that the drilling spindle can be twisted every way, so as to point forward or backward, or in any direction, and still retain all its automatic faculties.

In certain interior details of the mechanism, for the automation motions, it was not so rigidly correct in principle, as the slotting machine was throughout; nevertheless, it seemed to have more commendation from visitors.

Screw Cutting and Slide Lathe.

A large and massive screw-cutting and slide lathe was a most creditable production. It likewise had one fault in the shape of a feature inherited from the mother country, and which is too frequent in the United States, but which is never employed by the best makers of either country, namely, the shifting head stock which was made for transverse movement in order to produce tapered work, instead of by adjustable guide bar, to direct the line of the transverse slide upon the saddle.

Moulding Machine.

The same firm also exhibited a grand moulding machine for all sorts of wood planing work, which was as good in all respects, design, materials, and workmanship as could be desired. It was also most convenient in its arrangements, amply powerful, and performed its work both smoothly and rapidly.

That a young country like Canada should be sending to an exhibition machine tools of such a high class, which are not only to be considered remarkable, but also to be deserving of criticism, is one of the signs of the times to be noted. Machine making knowledge is extending in all directions, and it really appears as if engineering would soon be as common as carpentery has been in times past.

Wood-working Machinery. Waterous Engine Works Company.

Canada, as might be expected, had some good machines for wood-working, by different makers. One of the most remarkable was an exhibition of portable saw-mill machinery by the Waterous Engine Works Company, which was much admired, both for the convenience of its arrangement and for the

facility with which it could be removed from an exhausted part of the forest to a new situation. In this mill, notwithstanding its portability, were to be seen the leading features of the sawing apparatus used in the timber trade of America, inordinate strength and great concentration of power, with less regard to the economy of wood than to the rate of cutting. To a single circular saw of 66 inches in diameter there was a portable steam engine of 20 horse power. With such a powerful machine the planks fall from the log as fast as two men can carry them away.

Large Circular Saws.

The display of large circular saws, made by Canadians, was splendid, and so far as could be inferred from an examination the quality was all that could be desired, but there was no testing of such articles as saws at the Centennial, to know how good they really were. Several of the saw-makers strongly urged the judges to subject their goods to the severest tests, and offered to bear the expense, but the limited period of two months at their disposal precluded the possibility of conducting such an extensive course of experiments as would be satisfactory. Such testing, to be genuine, ought to include not only the quality of steel out of which they are made and the temper which has been communicated, but also the form which has been given to the teeth by different makers, as well as the comparison of inserted teeth with teeth cut out of the plate. Those tests would afford information on comparative endurance and cutting qualifications. Unless those points are clearly known no mere exhibition of saws, however large or splendid, can be little more than a show. The raising of such questions at these international gatherings, has an important effect on the advancement of quality, for although exhibitors may defend points of inferiority before their competitors, still they leave with a doubt upon the mind, which leads to future rectification.

The display of large circular saws at the Centennial was enormous, more especially in the American exhibit. It was, however, a subject of regret to many, that there were none to be seen from Sheffield, the fountain-head of this branch of practical art.

Absence of Sheffield.

This was the more to be regretted, because, there were so many users of such articles visiting the Centennial from all parts of the world, who are likely to go home with the notion that Sheffield has given up the manufacture. The men of Sheffield will find out that they cannot afford to hang back at these competitions, whatever the trouble or expense may be, and nothing less than fighting in the front at every encounter will maintain our prestige.

Germany.

German Machinery, 46 Exhibitors, Messrs. Kalke & Dotlessen of Hamburg.

Great expectations were formed by those who remembered the splendid display of German machinery at Vienna of what that country would exhibit at Philadelphia, but the actual results were disappointing. United Germany was represented by only 46 exhibitors of machinery, and these include none of her best-known firms. In Group 21 there were only three that need be mentioned. One in particular was an entirely new device for cutting the teeth in small bevil wheels, which was exhibited by Messrs. Kalke and Dotlessen of Hamburg. This claims to cut and shape the teeth in a geometrically correct fashion, by one passage of the ordinary circular cutting instrument.

The distinguishing peculiarity of this machine consists in giving a regulated lateral motion, a sort of wabbling movement to the revolving cutter, this movement being so graduated as to leave the true conical lines upon the respective teeth, each line being directed to the point where the cones terminate. Whether the machine in question is strictly correct or not, is not easy to say, for there were no instruments at hand sufficiently refined to prove the claim; still if it should turn out to be only an approximation, yet the same principle may be further developed to enable this class of wheels to be shaped as easily as spur gear.

Grinding Machine.

There was another German tool with a trace of originality. Its purpose was to grind metallic surfaces with an emery wheel at high velocity. Throughout the American portion of the Exhibition this class of machinery was brought prominently to the front, and a large amount of thought and ingenuity has been brought to bear upon it—for a variety of trades and purposes; all

going to show that the chisel and the file are in danger of elimination from the workshop for the majority of purposes for which they are now employed,—a fact to be noted. The machine in question is constructed like the ordinary planing machine for metal, with an emery wheel instead of the cutting instrument.

Its peculiarity consisted in the worktable making a slight dip automatically on the return stroke, to avoid the risk of contact with the article under operation, and consequent danger of fracturing the emery wheel. The same idea was embodied elsewhere. but the simplicity of this modification, consisting of inclined planes under the table, with a short slip upon them at each return, was novel.

Watch Making.

None of the machine tools from Germany were in good style of construction, and fell far short of the Chemnitz standard. An exception existed, in regard to a smaller class of tools from Munich, used in the manufacture of watches. This branch of industry is undergoing a great change in Germany and Switzerland, and still more in America. The making of watches is being reduced to a system like to that of small arms, and with the same result. It is for our manufacturers to take note of the fact. If we are content to adhere to the old fashioned tools, while our competitors are calling in the aid of a higher intelligence for the devising of a system of mechanism which affords precision sufficient to make the parts interchangeable and at a reduced cost, we run the risk of losing our watch trade altogether, except, perhaps, for the highest quality of chronometers.

France.

French Machinery, 100 Exhibitors, Quintinie, Arbey, of Paris.

France had about 100 exhibitors of machinery altogether. In Group XXI. there were very few. Still, most of the machine tools from France were characterised by elegance, refinement, and precision, more especially those for goldsmith's work, by Quintinie of Paris. It was a remarkable fact, to observe the quality of those French tools, more especially those sent by Arbey of Paris, they were so nearly perfect. At Vienna, Arbey was most distinguished for elegance of design, and for his system of instruments, and the mode of fixing them to attain security from centrifugal force. Arbey was equally distinguished at Philadelphia, and had the credit for being the only firm which used his system of planing with helical instruments. These instruments are arranged upon cylinders as in cloth shearing, or as may be seen in the lawn-mower. Arbey employs pieces of thin steel, which are properly tempered, and then wound round in spiral fashion, thus forming a parallel blade, which is secured by a suitable envelope, leaving only the cutting edge of the blade exposed. Another valuable speciality of this firm is the manner of sharpening the above instrument. Ordinarily, such tools have to be removed from the holder, and taken to the grindstone, but here they are sharpened *in situ*, by means of an emery wheel, which forms a part of the machine, and only comes into action when the cutting edge required revival, as determined by the attendant. The emery wheel passes along in a straight line parallel with the axis of the apparatus, and does its work promptly and with extreme precision.

Helical Instruments.

Stave Shaping Machine.

The same firm had another machine that attracted much attention. The object which it had to accomplish was to shape the edges of the staves of casks, so that when put together they may be perfect, and wine or water tight. At Philadelphia machinery for the manufacture of casks was very prominent, and much effort had been expended in devising ingenious methods to obtain the required conditions with the minimum of materials and labour. In this class of tools the Americans were particularly strong, but no other machine at the Centennial was considered superior for the intended purpose to that exhibited by Arbey, either for principle of action or practical efficiency. The prepared staves to be edged were bent down at the ends and fixed upon a holder of the same surface form as the cask interior when made. This holder is the top of an oscillating frame, the radius of which is that of the cask. The plane or geometric surface of one edge is at once made by the passage of a fine toothed circular saw at high velocity; then the oscillating frame is moved over a distance according to the width of stave, then the saw runs along the other

side, and the stave is complete. Thus giving all the requisite conditions with a simple and inexpensive machine,

Machine Forging by Hydraulic Pressure.

Both Germany and France submitted some beautiful specimens of machine forging by hydraulic pressure. The former also displayed an extensive collection of specimens from the torsion and tension testing machine, the fractures all indicating the finest quality both of iron and steel, which was most significant to those who were able to comprehend the lesson conveyed to the mind, and showing also the spread of experimental apparatus, by which our knowledge is not only extended, but is made precise in regard to strength and other physical properties, and the materials thereby, are economised.

Belgium.

Belgian Machinery.

M. Chaudron's Apparatus for Mine-sinking through water-bearing strata. Mont Cenis Drill-boring Apparatus.

Belgium, considering the extent of her metal and machinery manufactures, did not make a large exhibition of machine tools; still, almost everything sent to Philadelphia was very good, and a few of the articles were of the highest class. Two of the tools sent forward received as much attention as did anything sent from Europe, but neither of them fall into Group XXI., namely, M. Chaudron's apparatus for sinking mines through water-bearing strata; and, secondly, the actual drill-boring apparatus by which the Mont Cenis tunnel was pierced. The former was one of the most gigantic tools ever constructed; as a piece of mechanism it was simply superb, and was put together in the best style of modern engineering.

Machinery for making bolts and nuts.

There were few of the ordinary class of tools, a notable exception was a plant of machinery for making bolts and nuts, which was considered to be very superior and in advance of all previous arrangements of the kind, and acted with the precision of bullet-making machines, only that they deal with red-hot iron instead of lead, and with scarcely any waste of material. Besides, these machines were simple in arrangement, with the metal scientifically distributed throughout, in proportion to strain, and reflected great credit on their designer and constructer, A. Gobert, junior.

Sweden.

Swedish Machinery.

Sawing Machinery, Bolinder of Stockholm.

Sweden also sent her friendly offering to the Centennial. It was not a large collection, nor perhaps very original in design, but it was very good, and as a whole deserving of high commendation. A plant of sawing machinery by Bolinder of Stockholm was in excellent proportion and soundly put together. The framing was a model of neatness, and the whole was most conveniently arranged in the details. After seeing the saw mills of the lumber trade of America, an impression remains on the mind that saw mills as a rule are not sufficiently vehement in their action. This mill seemed to want the daring concentration of power shown in the lumber mills, and doubtless the machinists of all nations left the Centennial with their notions of timber working considerably altered. The same firm had an interesting show of cartridge making machinery, many of the details showing great ingenuity, and as a whole capable of turning out excellent work. But the Centennial was a severe ordeal for machinery of that class, as the United States government building contained an exhibition of the national machinery, all in full operation and mostly automatic in their movements. Besides that, a private American firm, Pratt and Whitney, had a cartridge machine that excelled the government machinery. It was not only automatic in the ordinary sense of attending to its own feeding and other wants, but in addition, it had the faculty of criticizing its own work and could use its own judgment at each stage of the cartridge making process, passing the perfect and rejecting any that had the slightest defect, with the embodied intelligence of an expert.

Cartridge Making Machinery.

Lathes.

Sweden exhibited a few good tools of the lathe class, for screw cutting and other purposes, and made a fine display of circular saws of all sizes which were highly creditable in appearance, and judging by the quality of material shown in several shavings of the same material, there was no doubt that the saws were as good in reality as in appearance.

Cork Cutting Machines.

Much regret was expressed that Sweden did not send her cork cutting machinery to the Centennial. It was inserted in the catalogue, but had not

arrived in the fourth month of the Exhibition. This plant, both for originality and fitness for the purpose, took the highest place at Vienna, and would have done the same at Philadelphia. This plant of cork machinery was not only automatic in not requiring any assistance in feeding itself, and in carefully delivering the finished corks, but in addition, each machine was intrusted with the duty of sharpening its own cutting instruments, and was entirely independent of any assistance so long as its various organisms were in good order. It is interesting to notice this gradual development of higher faculty in tools. In the earlier stage men had to use their own mental faculty in the performance of every application of the instrument. Then came the second stage of embodying the using of the tool ideas in the mechanism, where the man has not to repeat himself, the tool, spining or planing or turning, without the man. Now we are entering upon a higher stage, where the tools have not only the embodied ideas of the second stage, but some have in addition what is tantamount to a reasoning faculty, the power of putting several ideas together, summing up the conditions, arriving at a sound conclusion in an instant, and acting upon it, and seldom making an error in judgment. How many stages higher they may go, it is not for us of this generation to say; our present duty is to note the facts.

Russia.

Russian Machinery.

The European nation that affords the clearest evidence of gradual and decided improvement as a learner in the construction of machine tools and other machinery is Russia. This was shown by an improvement in quality at each recurring exhibition. The fine display which that country made at Vienna took many by surprise, and as a whole it was greatly in advance of all former efforts. When carefully examined, however, the collection exhibited at Vienna by Russia showed too many traces of school teaching, and a considerable deficiency in certain kinds of practical elementary knowledge pertaining to the handicraft resources of the workshop, that are indispensable to ultimate proficiency and commercial success. At Philadelphia the change for the better was very marked; there was not much to judge by, but almost every article or tool put forward was nearly perfect in regard to construction and workmanship. The style and general design was after the best examples of other and more advanced countries, without any effort at originality or even novelty. The firm of Lessner of St. Petersburg was remarkable even at Philadelphia for the beauty and excellence shown in two grand tools that would do honour to any country.

Lessner of St. Petersburg.

Radial Drilling Machine.

One of those tools more especially, a radial drilling machine, was superb; solidity without clumsiness, strict harmony in every outline, and fitness in all that determines efficiency for its special function.

Turning of Locomotive Wheels.

The other tool was of the heavy lathe order, specially adapted for the turning of locomotive wheels, and for its purpose was probably the second best in an Exhibition distinguished pre-eminently for that class of tools.

Technological Schools, Moscow and St. Petersburg.

The most attractive feature, however, in the Russian collection at the Centennial, was an exhibition of models and machines, either whole or in part from the technological schools of Moscow and St. Petersburg. The numerous articles exhibited were made by the students during 1875 and formed part of their education. The object of these schools is to prepare young men for the management of mechanical workshops, or to take charge of the rolling stock on railways, or for similar duties throughout the empire. The course of instruction extending over five years, a considerable portion of the time is spent in manual labour in mills and workshops belonging to the government.

Hand Instruments.

The collection at Philadelphia contained in addition, the numerous hand instruments that are employed in laying out work with accuracy during construction. All were fully matured in their design, and admirably carried out in the details. Considered as implements or tools, they were most instructive for students, all tending to the saving of labour, and for the attainment of accuracy.

Sundry Machines.

The articles exhibited, that were made by the students, consisted of lathes, planing machines, parts of steam engines, various descriptions of valves that

are noted for economic working, such as the double-beat, Corliss, and slide, and also governors and a variety of other things, all well designed and made, and reflecting credit both on teachers and students.

Brazil.

Brazil Machinery.

For Coining.

The Empire of Brazil is aspiring to be an engineering nation, and the Exhibition contained some good evidences of her mechanical skill. Most of the machines exhibited were sent from government workshops. The most conspicuous example was a very creditable plant of coining machinery, which was shewn in daily operation. This is a class of machinery which has already undergone so much elaboration and refinement by the best mechanicians of the older countries, Maudslay, and other master minds of the past, that it is not an easy task now to bring out any new type or marked improvements. Hence it may be inferred, that originality in this instance was not the distinguishing feature. At the same time this Brazilian plant of coining machinery was certainly well made, and although it contained a few evidences of a second-class style of workmanship, yet, taken as a whole, it was worthy of high commendation.

United States.

United States Machinery.

The display of machine tools made by the United States was so vast, that only the more salient points can be noticed in a brief report. It showed certainly, that the past century has not been passed in idleness, and judging by the enormous stride made by them during the past few years, it showed that they have been intelligent students of the best European authorities. It is true to say, however, that the Americans as a rule are not copyists; the inventing of clever devices, and tools for saving labour, seems to be their natural forte, and worthy of the old stock, probably quickened by the peculiarly favourable circumstances under which they live.

Machines for all purposes.

It was the display made in this section of the Exhibition, which most conspicuously brought out the enormous strength of America as a producing power. More than a hundred exhibitors had each a large exhibit that commanded the admiration of all who took the trouble to examine them in detail. In this vast array there were machines for all purposes, small arms-ammunition, sewing machines, clocks, watches, and all the branches of machine-making and engineering, and almost all were finished in a style superior to that of any former exhibition.

Watch Company of Massachusetts.

Probably the most exquisite set of machine tools ever made, was that exhibited by the American watch company of Massachusetts.

No mere words can convey an idea of their high standard of excellence: they must be carefully examined, handled, and felt. What the Whitworth standard gauges are to true circles and exact dimensions, these lathes and tools are to all forms required in the manufacture of watches. Add to this, great convenience in arrangement and fitness to produce the parts of a watch so exact, as to be almost interchangeable.

Ames & Co., Chicopee, Lathes, &c.

Perhaps the next in the same exquisite style, but applied to a heavier class of machinery, was the tool collection of Ames and Co., of Chicopee, the same firm which made the gun stock machinery for England, and which is now well known in Europe. The lathes and other machines by this firm were finished as accurately as standard gauges. No higher praise can be given, but the comparison points to a standard of quality not easy to reach, rarely seen, but much wanted for many branches of art. An original and special machine in the same style of finish, for tracing a copy and transferring the design, carving, or engraving, as in profiling or die-sinking was exhibited. It was a treat to be allowed to feel and handle this machine, so as to be able to appreciate the universality of its slide movements, the slides fitting as tightly as the gauges referred to, yet so softly and easily, that scarcely any pressure was required to move them in any direction.

Pratt & Whitney.

The firm of Pratt and Whitney, had a fine exhibit of more general tools, as well as of special tools for the manufacture of interchangeable small arms, including standard gauges and every kind of screwing taps and dies both

Whitworth and American. The whole display was of the most refined character in all that relates to style and precision.

Putman Company.

The Putman Company, made a large and grand display of the heavier class of tools for engineers, all most carefully constructed throughout. No tools in the Exhibition were more splendid in appearance, but their weak point was that the exterior finish of the bright parts was overdone. They gave the impression of being electro-plated, but they were only burnished. This was a caution; tools cannot be too good in essential points, but any appearance of finery for its own sake tells the wrong way. The brilliance of this exhibit commanded admiration from the passing public, and they were admired by engineers for their sterling worth at the same time, notwithstanding the extra polish.

Brown & Sharp.

Another firm, Brown and Sharp, had a most interesting collection of the class of tools in which precision is the leading characteristic, and of the lighter class of lathes and machines for special purposes, where the interchangeable virtue is an essential requirement. The whole display was of the highest excellence in quality, and faultless in regard to taste and style.

Corliss.

It seems almost invidious to select particular firms, because there were so many others almost equally good, but there were two firms present, who commanded more attention than any yet mentioned. One of the firms was that of Mr. Corliss, the firm who made the great central steam engines.

Machine for Bevil gearing.

Alongside the Corliss engines, there stood the machine whereby the teeth of the Centennial bevil gearing were shaped, and for originality of design it was probably one of the finest special tools ever constructed. It was the invention of Mr. Corliss, and though somewhat uncouth in appearance, exhibited great refinement in the details. The required mathematical lines for wheel teeth, were traced from a steel copy. The accurate numerical division was obtained from the periphery of a surface wheel fifteen feet in diameter, by rigid means which held the entire system fast as a rock, and which could be readily adapted to any division that might be required in practice. The tool was also remarkable for the manner of double keying the dividing wheel upon its axis, and for the various adaptations of the index plate to secure accurate adjustment.

Its most prominent and distinguishing feature, however, was the part which carries the planing apparatus. It consisted of a swinging radial arm or frame. held in equilibrium, which traces the steel copy, and guides the cutting instrument in shaping the teeth. Its position is always parallel with the required line of cut, and its centre of motion is the mathematical point in which all the converging lines of the cones of bevil gear terminate. The mechanism employed to set in action the cutting instrument was a rack with teeth, not rigid in the usual manner, but always conforming to its required position in relation to the driving pinion. In these and other highly characteristic details, this tool for cutting gear teeth, bears striking testimony to the mechanical genius of Mr. Corliss, whose machines as a whole, including steam engines, steam boilers, and mill gearing, were perhaps the most imposing, important, and even splendid, shown at Philadelphia by any single individual.

W. Sellers & Co., Philadelphia.

The greatest display of machine tools, however, and that which dwarfed all the others in the tool speciality, was made by the celebrated firm of W. Sellers and Co. of Philadelphia. This collection of machine tools, was without a parallel in the history of exhibitions, either for extent, or money value, or for originality and mechanical perfection.

Altogether there were about forty distinct machines, most of them large and many of them of gigantic proportions, but all characterized by extreme refinement to the minutest details. Besides, it was thoroughly national in its character, and pre-eminently worthy of the Centennial.

Steam Hammers.

A steam hammer shown by this firm, was remarkable for the elegance and originality shown in several of its details, in the form and arrangement of the hammer proper, for the manner in which the hammer-head is secured to the hammer, affording great convenience in fixing and unfixing. Also for novelty in the mode of working the steam valve and several marked improvements in connexion therewith. One of the machines was for producing flat surfaces, and although a new conception, was here developed into a practical tool for the engineer. Sir J. Whitworth was the first to develope the true surface

plate system, which has hitherto been arrived at by planing and scraping, depending on volition for the ultimate perfection of a true plane. In this new idea, the true surface of a perfect table, is transferred to other surfaces, by moving the latter over a grinding instrument in the middle of, and on the same true plane.

The most important feature is this, that the surface to be made true, may be of any degree of hardness, even chilled cast iron or hard cast steel, thus opening up a new field of endless application for slide valves, and for many parts of tools and machines where extreme hardness is a virtue. In lathes of all kinds, this firm is remarkable for mathematical accuracy, and all were furnished with original devices, which enables a zealous workman to develope the produce of the lathe to its utmost capability, yet without physical effort. By the introduction of an under V within the bed, the shifting head is always drawn to the same straight line, thus avoiding the necessity of a tight fit within the shear, and its consequent disadvantages. Their system of feed motion is admirable, a simple combination of discs, whereby the feed rate may be altered from one extreme to another, or to any intermediate point, by a mere touch.

Lathes.

Planing Machines.

Their planing machines are famous in Europe, and are now being copied in all countries. One of the largest ever made which planes automatically in three directions, is now under construction at Philadelphia for a Russian arsenal. These planing machines are distinguished for directness in the transmission of power. The trammels which have hitherto kept engineers to spur or bevilled gear, are broken through; they employ the old gear only when it is the best for the purposes, but if not, they devise a new and special gear going straight to the point in whichever direction it may be. This is shown in several of their machines including the planing, and naturally raised controversy among experts. The devices employed to give the feed motions at the proper point and to avoid a struggle between the open and cross belts at the reversing moment are most ingenious, and were much admired by the judges. One of the most striking features of the American section is the variety of special tools for all sorts of purposes. In this also they take the lead. One example, was a lathe for brass work, employed in making the water injector for steam boilers; considered as a combination of clever devices to accomplish a definite object, it was a fine tool.

Lathe for Brass Work.

It enables an intelligent man to accomplish more work in turning, boring, screwing, or fitting, than is possible in an ordinary slide lathe, which is intended for general work. Besides, it is less dependent on the workmen for accuracy.

Gear Cutting Machine.

It was the general opinion among engineers at the Centennial, that this class of machinery will have to be more and more resorted to, as competition intensifies, because it reduces cost of production and raises quality. Messrs. Sellers gear-cutting machine is also well known in Europe. It is entirely and strikingly automatic. It receives its work and performs it to the end, shifting from one division to another, until completed, no attendant workman being required meanwhile. Even the mathematical curves of the circular cutting instrument, including the curve of clearance, are all predetermined and embodied in a machine, irrespective of any future intelligence having to be exercised in their production; still more, the curves are such, that as the cutters wear through use, the fresh lines presented at each sharpening, are ever mathematically true as predetermined.

This example of the material embodiment of certain refined geometric ideas in one machine—the faculty of foreknowledge, by which it is capable of transmitting the same in perpetuity to another machine—the gear cutter, is remarkable. This automatic cutter former, considered in connexion with the automatic gear cutter, requiring no attendant, one man being able to attend upon four machines, is suggestive. And this degree of mechanical culture in the gear cutter, is the condition that all our tools have to be brought up to man's intelligence, designing and directing, while the iron slave performs the drudgery.

Heavy Shearing Machines.

A marked change is coming over the construction of heavy shearing machines.

Usually, the entire strain of the shearing action, comes direct upon an eccentric with all its accompanying friction and wear. In a series of grand

machines shown by Messrs. Sellers, this inordinate pressure is distributed, by the intervention of a lever within the framing, thereby saving power, and securing much greater endurance in the vital parts of the machine. One of these machines with a shear of nearly five feet, was employed in cutting thick plates, and upon an entirely new plan, which attracted much attention. It was automatic in its several movements, and so contrived, that it cuts up to a definite point upon a line as previously determined, and then stops of itself. This is one of the machines into which the direct style of gear has been introduced with great advantage, both in first cost and ultimate economy.

Two of the articles exhibited by Messrs. Sellers were English inventions with the inventor's names put prominently forward.

Mr. Batho, Nut-shaping Machine.

A nut-shaping machine by Mr. Batho was one of them. By a singularly simple, yet most ingenious conception, Mr. Batho has devised a system of synchronous instruments which act simultaneously upon each of the six sides, yet without coming into contact or interfering with each other. A score of nuts are strung upon a mandril, which automatically passes through the circle of cutters, either up or down, with a constant stream of oil, kept up by a circulating pump which is part of the machine, and serves to maintain the cutters in good condition.

Mr. Ralph H. Twedell, Hydraulic Rivetting Apparatus.

The second English invention was the hydraulic rivetting apparatus of Mr. Ralph H. Twedell, which has already found admission into some of the best workshops of America. This admirable tool is a decided advance on all its predecessors. It is simple, it affords a controlled pressure, and acts with promptitude and certainty of action. And besides its portability, it performs its work in perfect silence. Both machines have been modified for the better by the American makers, and both inventions seemed to be highly appreciated by the engineers who examined them. The inventors' names being more familiar among the Americans, than on this side of the Atlantic.

Rotary Puddling Machine.

The same firm exhibited a rotary puddling machine which received much attention. The vessel was built up of wrought iron, with water circulating arrangements, and lined in the usual manner. It worked at right angles to a furnace, the open end rubbing upon the side. An independent steam engine was employed to work the vessel, which was perfectly under control to turn either way as desired, or to step backwards, or to advance close to the furnace side. No luting was employed where the vessel touches the furnace, both surfaces being turned, and was reported to keep free, and fulfil all the necessary conditions.

There was no fire in the furnace at the Exhibition, but otherwise this interesting tool appeared to be ready for work.

Smithing and Forging.

The Exhibition was rich in everything that relates to smithing and forging. All classes of articles seem to be made by transfer from copy. A profusion of drop hammers of various systems of construction, adapted for different classes of work, were shown in abundance.

Trip Hammers.

Trip hammers, peculiarly American in design, were exhibited in action. Padded most ingeniously with india-rubber, they were driven at 500 blows per minute with impunity. With a single heat they can draw down a piece of steel one inch square and six inches long into a rod five feet in length; as the heat went down at any part a few seconds under the tilt brought it back to redness, so that it seemed as if the drawing process could be prolonged indefinitely.

Workshops.

It was in the workshops, however, that the earnestness of American smithing and tools was seen to the best advantage. Where articles have to be repeated, as in making the interchangeable parts of railway bridges, there is scarcely any skilled handiwork required. Coloured labour, brings forward the bars of iron on trucks or otherwise; the ends of the bar are heated in a furnace, and then put into a set of dies which are surrounded with, and worked by hydraulic pressure.

Hydraulic Forging Machines.

A touch of a handle by a skilled attendant, causes the dies first to hold firmly, and then to set up or shorten and squeeze the hot iron into form. If there is a hole to be made, a taper mandril passes through the dies, driving the red hot iron into every crevice of the steel mould, the whole operation occupying only a few seconds. In connexion with these hydraulic forging machines, an accumulator is used, and the cylinders being of large diameter, the hot iron is like soft clay in the hands of the potter, and pieces of work that would occupy a good smith with a couple of strikers for half a day, are made perfect at once and at a small cost; the chief expense

for labour, being the removal of the bars of iron to and from the smithy. The great expense is in the tools and plant, which could only be incurred in a country where the work is systematized to admit of repetition.

Iron and Steel.

In the mechanical section of the Exhibition, there was nothing which had greater significance than the fine specimens of iron and steel shown by different countries. In this branch of practical art the United States made a deep impression.

For torsional, tensional, and malleable qualities, the samples shown were equal to the best of any country.

John Roach & Son.

The collection of John Roach and Son excited great admiration; one plate, said to be the largest ever made, was 28 feet long, 8 feet 6 inches wide, by ⅝ inch in thickness. A specimen of the same quality of iron worked into shape to form the end of a steam boiler, was an extraordinary example of plastic malleability.

It was 106 inches in diameter, and flanged 6 inches deep around the outer edge. Upon the opposite side of the plate four other flanges were worked out around four equidistant holes 30 inches in diameter, these flanges being 4 inches deep.

As a piece of smith-work it was faultless. The owners, and the Americans generally, were evidently proud of such smithing.

There are few men in the world with the combination of qualities that could take in hand and execute such a piece of work for the first time. What a satire is here afforded on the modern doctrine that all men should have the same rate of pay. It was pleasant to be informed that the smith who made it, was an Englishman, and it was generous of the Americans to give the information so freely.

Machine for Ramming Sand in Moulds.

Comparatively few of the founder's tools or appliances were brought to the Exhibition. There was one example of a mechanical apparatus for ramming sand around the pattern in moulds, but it did not appear to be very efficient. In the foundries, however, were to be seen numerous peculiarities that were interesting to Europeans.

One of them, is the mode of clearing out the cupola when the cast is over. The bottom is hinged and kept up by a prop, when the prop is removed the bottom drops, and the viscous slag with the burning fuel falls upon the floor, without assistance.

Another point to note, is the manner of using the drying stove, a revolving table in the centre, on which the cores are laid, handed in through an aperture in the wall, thus avoiding entrance and loss of temperature.

Moulding.

In moulding the smaller class of articles, but one flask or box is employed, when the pattern is withdrawn, the entire mould is laid on floor ready for casting at the end of the day, but the box is hinged at the corners and the founder deftly removes it, leaving the sand mould intact; in this manner one box may serve for fifty moulds which are ranged upon the floor flaskless, until casting time.

As in our own more advanced foundries, they employ the stereotyped system of patterns for almost every class where there is repetition. Some of the more advanced, draw the stereotyped patterns through the iron plate, even in articles of large dimensions; pullies up to five feet in diameter. With such refined means the castings are simply perfect. They also sift the sand by machinery, trim the castings by the emery wheel, and clean the surface by sprinkling with a weak solution of acid, the castings being laid in heaps upon an inclined plane, and polish off the surfaces in a revolving drum.

General.

All through the Machinery Hall there was an extraordinary profusion of every sort of tool and appliance for the use of engineers and machine makers, too numerous to be referred to except in general terms. In the art of drilling metal, the Americans for years have taken the lead. They were the first to introduce the systematic use of the twisted drill.

Twisted Drill.

This instrument has important advantages over the common drill.

It forms a correct guide for itself to bore a straight hole, it cuts out the substance as a shaving, and it maintains its diameter to the end. Mr. Morse did for drilling implements what Sir J. Whitworth did for screwing apparatus, by systematically assorting valuable tools in neat cases, thus introducing a most refining influence into the workshop.

Morse Twist Drill Company.

The Morse Twist Drill Company made a most beautiful display of drills and the finer class of engineering instruments, circular cutters of all patterns, screwing implements, Whitworth and American, and standard gauges of a refined character in all essential qualities, and neatly milled on the exterior surface to facilitate in handling and using.

From the part taken by this firm during past years in spreading their system of drilling all over the world, their good influence is felt wherever their drills find an entrance.

It is also to be observed, that American drilling machines are undergoing a new development. Spindles, are now nearly balanced, the preponderance being on the side of the counter-balance which is usually in the interior of the framing. With the counter-balanced spindle, the drill does not drop in passing through, thus avoiding fracture of drill. Spindles are arranged for a quick free movement, both into and out of the hole, the automatic or hand feed, only coming into play when drilling commences. Another change, nearly universal in the American machines, is the introduction of an index to show depth of penetration, without having recourse to the withdrawal of spindle. Other machines are arranged for being previously set for a determined depth, the machine having the automatic faculty of withdrawing when it reaches the required distance. This advantage, combined with the self-clearing property of the twisted drill, enable more and better work to be done, and although apparently trifles, yet each one points to greater efficiency and economy.

Driving Drilling Machines.

A new idea is now prevalent in America in regard to the manner of driving drilling machines, which seems likely to alter their system of construction almost entirely. They find that with a given quantity of power, more work is done with a belt alone than with the usual system of wheel-gear intervening. This fresh light dawned upon them unexpectedly. A certain article required in great numbers was at first drilled in geared machines entirely. During an emergency belt drills were extemporised as a makeshift, when it was found that the workmen, on the new tools, made more piecework wages than the other men. At first the advance in production was accredited to the superiority of the new men, but on transposing them, it was found to be due to the belt system. On further experiment, it was found that spur-geared machines only, were superior to machines having the customary bevilled gear in addition. Accordingly, the belt unaided, is superseding the gear system, in the best workshops, for all drilling where repetition is involved.

Sharpening Drills.

Another important feature in their workshop economics, is the manner of sharpening drills.

The drills are not held in the hand, but in an instrument which presents the drill to the grinder in a manner which insures positive truth in the cutting edges, besides mathematical accuracy in the angles, thus rendering the drill more efficient, and affording more and better work than is practically attainable by the rule of thumb system at the grindstone. In the Exhibition there were shown several of such drill grinding contrivances, that by W. Sellers & Co. was considered the best.

Emery Wheel.

The grinding agent in all, was the corundum or emery wheel, chiefly the latter, and in none did precision depend on the skill of workmen.

A new departure has been taken by the Americans in punching metal, and the same principle governs shearing and detrusive operations generally.

Hoopes & Townsend, Philadelphia, Novelty in Punching.

The firm of Hoopes and Townsend, of Philadelphia, exhibited this great novelty in punching (not shown in operation), which created a sensation among engineers from all countries, the United States included.

The articles shown consisted chiefly of nuts or other similarly perforated specimens; all were of remarkable beauty, and were given away in profusion. These nuts had two peculiarities, they were of inordinate depth, and showed clearly that they had been punched cold. Visitors, however, did not hail this new fact in practical science; they said it was an impossibility for a $\frac{3}{8}$-inch punch, however good the quality of steel, to penetrate through $1\frac{3}{4}$ inch of cold iron, that whatever might be the explanation, a punch of that diameter could not do it without being broken or crippled.

Fluid property, Cold iron.

In time the secret leaked out, for it was no imposture. This firm, in punching, take advantage of the fluid property of solid cold iron or steel, by introducing the element of time into the performance of the operation, giving to the punch only such a load of pressure as it can comfortably sustain, then

giving up the reins to nature, when the instrument penetrates at a rate dependent on and in proportion to the fluidity of the mass. Hitherto the philosopher and the experimentalist have been writing upon the flow of solids, no one heeding; but here at the Centennial, was the natural law made practically available, and unimportant as it may seem, yet vast issues are bound up therein. The seed there sown in thousands of thinking minds, will bring forth many other applications in metal working, and will lead to the performance of many operations that are deemed impossible at the present time.

Pipe bending. A characteristic American novelty in pipe bending was exhibited. Hitherto when thin metal pipes or tubes had to be bent, it was necessary to fill the pipe with some solid substance, in order to avoid alteration of section at the bend; the solid substance being afterwards melted and run out.

Spiral Mandril. By this new notion, a spiral mandril is used, the spiral tube yields with the pipe in the bending operation, yet fills it sufficiently to prevent collapse of the exterior tube. It is easy to remove the spiral, by simply twisting it in the same lead, hence reducing the diameter, which allows it to be drawn outwards. This ingenious employment of the spiral mandril for the common purpose named above, will for similar reasons, lead to applications for other operations in different directions.

Spiral Shaft Such another use for the spiral, was shown in operation. Here the spiral tube was employed as a shaft for the transmission of motive power, which, from its flexibility, permits of being bent or presented in any required direction. As an American novelty this spiral shaft was exhibited in Europe a few years since, but at the Centennial good serviceable work was being found for it, and for which it was particularly well adapted,—drilling round a corner, or into other awkward places. More especially for polishing irregular surfaces, ornaments in stone or glass, or indeed for any sort of figured work in the various branches of ornamental practical art.

Substitution of Emery Wheel for Planing Machine. Another notable change is going on in the American workshops, which was profusely illustrated at the Exhibition. The emery wheel for a vast variety of purposes is being substituted for the planing machine and other tools of the engineer; not by a recurrence to the old system of haphazard grinding, but by well defined movement, rendered as certain in its action as the ordinary tools employed in the various branches of engineering. These grinders are made in all forms as required, and are applied to machines as varied in construction as those for wood working. Some of the machines for trimming rough castings were arranged for vertical spindles, with conical grinding wheels and with the table adjustable in regard to its relation to the spindle. The rapid rate with which the lumps and parts of runners, the fins or other excrescences, were removed from rough castings of all forms, was most interesting to observe, showing an earnestness of purpose and an amount of good sense in the means employed not to be overlooked. All these changes denote economy of production. Considered as a whole they teach an important lesson which every competing nation should study. In 1854 these emery wheels were first introduced into England, being employed at Enfield for sharpening hard cutters, the system having been brought from America. Since that time great progress has been made in further applications all over this country, but our progress has been slow, when compared with the rapid growth and wide spread employment of the system in the United States.

Machine Tool Makers. Another point to be observed in passing, was the circumstance of machine tool makers, being the constructors of the lighter kinds of mill gearing for all descriptions of factories. This seems a good arrangement, because no class of machinists, from their training and knowledge of tool production, are more likely to give a tone and efficiency to this important branch of manufacture. The firm of W. Sellers & Co., for example, are great authorities in this class of work in the United States. One of the partners having made the subject his speciality, has taken up the subject of the transmission of power at the point where it was brought up to, by the late Sir W. Fairbairn.

Mechanical Details, Advance. The advance since made in perfecting mechanical details, owing to the peculiar turn of American genius and their refined ideas of machine tool work and its execution, was quite a study, being efficient, simple, and economical. This firm exhibited in detail all the minutia of their system. To summarize the chief points of this mill gear system—all the parts are produced by boring

and turning; all dimensions are reduced to standard gauges; the double cone couplings which unite the parallel shafts are simple and of easy attachment; the system of fastening by keys and keyways is almost entirely eliminated; the hangers are light, adjustable *in situ*, and all bearings are on ball and socket joint; affording uniform distribution of pressure; extensive bearing surfaces to reduce wear; the length of bearings equal to four diameters; pullies light, balanced, and fixed in such manner as insures truth, yet fits easily upon the shaft and can be shifted with little trouble. To give the minutiæ would be inconsistent with the primary object of this report.

Critical Examination of Machines before delivery.

A notable feature to be mentioned in regard to the manner or system of conducting machine making establishments in America, is the method of critically examining the several machines before delivery, in order to make certain that they are strictly correct in every particular. This applies more especially to the class of machinery where accuracy is essential, and to the workshops of first class manufacturers. The system referred to has been in partial operation in England for a long time, more particularly in government establishments for the manufacture of small arms and of certain other articles, but it has not yet met with acceptance, in many branches of industry. It consists in having two distinct branches in a manufactory, one to produce, the other to examine and criticise only, and to reject everything which is not perfect. To enable this to be done systematically, a book has been compiled by the respective firms, containing questions on each point, which have to be answered and signed by the examiner.

The effect at first, is to produce a sort of antagonism between the two branches, but it spurs and stimulates the working staff up to a degree of precision, not otherwise attainable, and after a time, it settles down into a normal condition, with most satisfactory results.

Wood-working Machinery.

Of wood-working machinery, as might have been expected, the quantity exhibited by the United States at the Centennial Exhibition was enormous. There were upwards of 80 exhibitors, each with a large collection, the greater number showing progress both in design and execution. The competition in this class of machinery in America is intense; yet the greater number of the larger exhibitors, give away valuable illustrated books, showing the minutiæ of all their machines, as if regardless of competition. They rarely copy from each other in vital parts, and the points in which they severally excel can only be copied by a master hand, already overflowing with new devices of his own. The impression is left upon the minds of European visitors, that American competition in machine tools will soon be upon us; but that the competition will not be in regard to price, but rather for high quality and productiveness, and the capability of doing more work with a given expenditure on labour. As an illustration of the rapid changes which are now going on, that of dovetailing as employed by the carpenter or cabinetmaker may be mentioned. At the opening of the Paris Exhibition in 1867 there were several saw combinations which approximately supplied the want, but their details were incomplete. After several months had passed, a new machine invented by Mr. Armstrong arrived from America, which all admitted to be perfect, its only fault being the cost. This machine was taken up by many of the best firms in all countries, England included, and at least half a dozen Armstrong machines were exhibited at Vienna in 1873. I did not observe a single one at Philadelphia, but saw five other machines without any similarity to each other or to the Armstrong. Their peculiarity lay in their simplicity and reduced cost. Another marked feature running through this class of tools consists in imparting to them the faculty of adapting their own arrangements to peculiar or unexpected circumstances. As an example, a remarkably clever machine was in daily operation, dressing the exterior surface of wooden hoops for casks. The hazel sticks or rods, with all their crooks and lumps, were fed into the machine and passed instantly through it. The province of the machine is to feel their exterior form, and then to dress the outer surface in conformity therewith, but not to disturb the fibre. This is a sort of duty that might be supposed to require judgment to do it properly. The necessary intelligence is embodied in the machine, and the work is done to perfection. It was also to be observed, that machines are having entrusted to them the duty of sharpening their own cutting instruments when they become blunted. This confidence was first exemplified in Sweden, and was shown at Vienna in

Paris, 1867.

Armstrong.

Vienna, 1873.

Automatic intelligence in Machine.

1873. At Philadelphia there were several examples, but in none was it done with better grace than in the Swedish case. At the Centennial Exhibition, however, there were some interesting examples of machines having the faculty of taking care of their more delicate members. One of the large band-sawing machines was shown in operation with a band saw, little more than a steel thread, doing work that seemed impossible, it was so fine. The secret of its not breaking was due to an understanding that exists between the fragile steel thread and the overhead carrier pulley. The pulley takes entire charge of its own inertia, and thus relieves the saw from its influence both at starting and stopping. The mechanism to achieve so much was simply the intervention of a light slipping medium. There were shown some interesting examples of automatic tools that encroach on the province of the sculptor in wood. Busts of Shakespeare and Dickens were being made to order, either in boxwood or planetree, at a small cost. In such machines, the form and likeness came by transfer from an iron original which had simultaneous movement with the wooden block. The cutting instruments made from 8,000 to 10,000 revolutions per minute, thus giving a fine surface, scarcely requiring more finish than a rub with sand paper to obliterate the marks of the tool.

Band Sawing Machines.

Automatic made Busts.

No department of the Exhibition created greater astonishment in the minds of European visitors than the saw-mill annexe. The sawing machinery came chiefly from the timber districts of the West, and has a character of its own. While the machinery of the Eastern side of America may be said to have refinement for its most prominent characteristic, that of the West is distinguished by daring boldness. There were nearly 20 of these mills in line or adjoining—all earnest competitors, and each provided with from 20 to 40 horse power, concentrated on a single saw. The limit of velocity being the tenacity of iron to resist centrifugal force, in one instance the driving pulley was thrown out into space, some of the pieces going through the roof like a cannon ball. In details the mechanism of these mills differs in each, but the general features of all are nearly alike. The log is fixed on the side of a long carriage that travels upon a railway, and is automatic in its several movements. The carriage runs with the log on to a circular saw, at a pace of from four to six miles an hour, and returns at triple speed. The most daring saw-miller at the Centennial was E. P. Ellis, from Milwaukie. He required a stream of water to keep down the temperature of his saw. The sawing of this mill was a sight not to be easily forgotten. The saw-mill most matured in all its details belonged to Mr. Stern, who is the oldest and most noted saw-mill maker in the United States; but this mill did not work, the reason given being a deficiency of steam power. Be that as it may, the machinery of this firm was superb. The mill of another firm, E. W. Ross and Co., seemed to be the favourite. It was almost equal to the best in rapid execution, and excelled in the economy of wood. Besides, it had many original points in the automatic motions, and did every movement with marvellous gentleness. As a piece of working mechanism it was of high rank, and suggested the idea that the designer had studied the self-acting mule of Richard Roberts. A powerful band saw was shown by C. Meiners, probably the largest in the world. The band is 8 inches in width, and is driven at a velocity of 60 miles an hour. It might be supposed that danger was involved, but it was reported that in practical working an accident was of rare occurrence. A fine display of circular saws of all sizes was made by a number of firms, all of excellent quality so far as the quality may be judged by mere inspection. The chief point to mention about them is the manner of treatment after the hardening operation. When large saws are made red hot, and then suddenly cooled, they are frequently bent and buckled. This is usually rectified by a skilful stretching of the rigid spots by hammer and anvil, which liberates the structure until at length it is a flat surface, and runs true as a saw. In the new American system, no hammering is resorted to. The buckled saw is compressed in a mould between two flat surfaces, the operation being performed in an oven made on purpose, which is carefully heated up to the proper temperature required to give the saw temper. The oven is allowed to cool down with equal care, and when taken out of the mould the saw is found tempered without being buckled. The Exhibition was rich in devices for sharpening the teeth of saws. The file is entirely discarded, the emery or corundum wheel being substituted. In most instances the truth of the saw

Saw-mill Annexe. Eastern States, Western States. Comparative Exhibits.

Mr. E. P. Ellis, Milwaukie.

Mr. Stern.

Messrs. E. W. Ross & Co.

Self-acting Mule, Mr. Richard Roberts.

Large Band Saw, Mr. C. Meiners.

Buckled Saw.

Saw Sharpening.

is determined by transfer from a template, one machine for this purpose being entirely automatic; when it has gone round the entire circumference it stops of itself.

In connexion with the lumber trade exhibition, an original contrivance for controlling great rafts of timber in the large rivers of the West was shown by Mr. A. Kempt, Wisconsin, which elicited admiration for its simplicity and efficiency. Hitherto, rafts have been guided by a number of men with oars, whose united efforts are frequently unavailing. In this new arrangement a series of rudders is temporarily hinged along both sides of the raft; those on either side are simultaneously manipulated by a single chain carried to the rear, where one man by means of a windlass can draw them out or let them in. When out, the rudders are acted upon by the current, which thus becomes the agent to urge the raft transversely to either side as may be necessary.

Timber Rafts, Steering Apparatus, Mr. A. Kempt, Wisconsin.

This Exhibition was remarkable for the number of efficient machines for working all sorts of stone. The chief feature of almost all of them is the employment of the diamond as the cutting agent. Former Exhibitions have been renowned for their display of diamonds as articles of ornament. At Philadelphia diamonds were in equal profusion; but they were used for the teeth of saws and drills to fashion stone to useful purposes. In regard to rock-drilling appliances, the greater number are similar to those employed in Great Britain. The stone-sawing machinery, however, is in advance of anything previously attempted, and most probably will form a new point of departure. the several articles exhibited, divide themselves into two classes—for reciprocating vertical or horizontal sawing with frame, and for circular sawing, the latter predominating. Most varied were the mechanical arrangements, but in three main points all unite. Every saw tooth is tipped with a diamond; an enormous concentration of power and velocity is employed; and, lastly, a deluge of water runs upon the point of action, to keep down the temperature and to subdue the shower of sparks. Much refined ingenuity is displayed in some of the methods devised for setting the diamonds, so as to secure them in such a thin body, and at the same time to give them a good rear support quite out to the cutting surface of the tip. The saws are about 6 feet in diameter, and the diamonds are of the dull Brazilian variety, and seem to do their work most admirably. The firm of Branch, Crooks, and Co. made a great impression by the completeness of all their arrangements, and the steady-going way in which their machinery sliced great masses of stone into slabs of any thickness. Equally remarkable was the display made by the Emerson Stone Saw Company, their diamond circular saw was reported to cut through 75 square feet of ordinary sandstone per hour, and other stones at a rate inversely proportioned to hardness.

Stone-working Machines.

Rock Drilling.

Stone-sawing.

Branch, Crooks, & Co.

Emerson Stone Saw Co.

The reciprocating diamond saws exhibited by Mr. Young of New York, seemed equally efficient, and were adapted for cutting through blocks of stone of the largest dimensions employed in building operations. This system of sawing stone with diamonds seems to be worthy of attention; that they are efficient is now made manifest, but no doubt their general adoption will depend on commercial considerations, which could not be ascertained at the Exhibition.

Reciprocating Diamond Saws, Mr. Young of New York.

It was not at the Centennial Exhibition however, that the application of machine tools by the Americans was seen to the best advantage. To realize the nature of the competition that awaits us, their factories and workshops have to be inspected, in order to see the variety of special tools that are being introduced, both to insure precision and to economise labour; this system of special tools is extending into almost every branch of industry where articles have to be repeated. This applies to furniture, hardware, clocks, watches, small arms ammunition, and to an endless variety of other things. The articles so made are not only good in quality, but the cost of production is extremely low, notwithstanding that those employed earn high pay.

Application of Machine Tools.

Another important point to be noted in connexion with this system of production, is the manner of detailing the cost of each operation. An article consisting of—say seventy parts, has each of those parts so detailed, that a price is affixed to each stage; every removal, every handling, costs something, and each one of these parts, that may ultimately be only worth 25 cents, is yet made up of many items. To enable this to be done, such accounts are not kept in dollars but in mils, the thousandth part of a dollar, which in practice

Cost of operations.

works out admirably, the summation of the decimal column being most simple. Where the above method has been established, the factory is worked with the precision of a cotton-mill spinning 40s only, and tends to reduce the cost of management and to check other indirect charges.

Concluding Remarks.

Hitherto we have been justly proud of the perfection of the system and organization in our cotton manufactories; what Arkwright did for the cotton mill, the Americans have introduced into numerous other branches, watch-making, for example, with equal advantage.

In past times, England has been the nursery ground of the manufacturing system, her factories have been visited, and her system of cotton and other textile manufactures have been copied by all nations, but the time seems to have arrived, when we shall have to visit America in the same way and for the same purpose, in regard to the production of other things, and there is no time to be lost if we mean to hold our own in the hardware trade of the world, at least in regard to the class of things that are required in large number or quantity.

Great Britain certainly can claim the credit of having been the birth place of modern machine tools, and has done wonders in raising the mechanical standard of perfection, and her influence for good in the advance of civilization thereby, is incalculable. But when we consider the enormously greater area of the American Continent, it is a matter of vast importance, that tools have taken such a hold of the American mind, which will influence the civilization of the Western World for ages to come, and will exercise a powerful effect, not only on that Continent, but on Australia, China, and the world generally: this therefore has a profound significance which can scarcely be overrated.

Britain and the United States are not on equal terms; by past exertion the former has become rich, the latter is still comparatively poor, but with an abundance of brain power in active exercise. America is much in the same condition as was Great Britain about half a century ago.

In this competition of tool devising, brains count for more than wealth, and will gain an advantage; under the same conditions the two nations will probably be found to be nearly alike, both have come of the same good stock.

Let the youth of Britain take note. Our past prosperity came by well directed thought. As it was in times past, so now it is the same. England's future greatly depends on the intelligence and mental activity of her sons.

In reckoning up the significance of this grand aggregate of machinery, and congratulating ourselves on its results, as showing how the toil of man can be mitigated while the wants of civilized life are abundantly provided for, it is impossible not to feel that an important change is approaching. A century ago no conditions existed which could have enabled Adam Smith to anticipate a time when the producing power of automatic machines would exceed the requirements of the human race. That state of things is rapidly approaching, and it is for the philosopher and political economist to consider carefully before-hand the impending revolution, so that it may all work for good to the family of mankind.

JOHN ANDERSON.

MR. FREDERICK A. PAGET, C.E.

MACHINES AND APPARATUS USED IN SEWING AND CLOTHING.

Report on the Machines and Apparatus used in Sewing and Clothing. By Frederick A. Paget, Esq., C.E., Judge and Secretary, Group XXII., Philadelphia; Juror Group VII., Delegate to Group I. and Off. Reporter, Vienna; Mem. Soc. Civil Engineers of France; Corr. Mem. Soc. German Engineers, and of the Franklin Institute of Philadelphia; Mem. late Government Commission on Chain-cable and Anchor Proving Establishments, &c.

1, Seymour Chambers, Adelphi,
Sir, September 1876.

In accordance with the wish of the Commissioners that a short report on the broad features of his particular section be prepared by each judge, the following general account is submitted. In the absence of drawings, which could not be included within such limits, it is necessarily incomplete, as the very best and most precise descriptions of machinery are extremely imperfect without delineation, the true, perhaps the sole, language of technology. It is doubtful whether the most precise description is not surpassed in distinctness by the simplest sketch; and even the most skilled expert may be puzzled by a verbal description, however precise. Scope of Report.

The exhibits examined by the following gentlemen, namely, Colleagues in Group XXII.

Edward H. Knight, A.M., late of the Patent Office, Washington, President;
Frederick A. Paget, C.E., Secretary, Great Britain;
George W. Gregory, Boston, Mass., U.S.;
L. D. F. Poore, Springfield, Dakota, U.S.

The Judges of Group XXII. were to take under consideration Class 531, including machines used in the manufacture of tapestry, lace, floor-cloth, fancy embroidery, &c.; Class 531, sewing and knitting machines, clothes cutting and folding machines, as also ordinary needles and thimbles; Class 534, or machines for ironing for tailors' use; and Classes 535–6–7, machines for making clocks and watches, jewellery, pins and needles, and for sticking pins upon paper. Practically, this resolved itself into a consideration by the Group of sewing and knitting and embroidering machines, clothes cutting, folding, and making machinery, ironing machines for tailors' use, and machinery for making watches, jewellery, and needles, and for sticking pins on paper. Each given machine was examined with respect to the:— Scope of Group XXII.

Points considered in examination.

1. Quality and quantity of work done, as evidenced by special *de visu* trials;
2. Simplicity of parts and motions;
3. Adaptability to different class of work; and
4. Quality of workmanship and materials;

For each of these qualifications an equal number of points was given. Then came—

5. Originality, as evidenced by the history of the development of the given machine.

In this point more especially we were fortunate in the aid of Mr. G. W. Gregory, a member of the Group, for a number of years one of the chief examiners of this class of machinery at the Patent Office in Washington, and now of Boston, Massachusetts. The careful examination required by the United States law before granting the strictly defined claims of every patent had rendered this gentleman *facile princeps* as to the history and strict apportionment of originality of every detail of the machines.

Then:—

6. Public estimation, as evidenced by the number of given machines sold;
7. Symmetry, as evidenced by external shape;

and lastly:—

8. Completeness of general display, the distance from Philadelphia being taken into account.

Practically this last point meant a certain favourable allowance being made in the case of foreign exhibitors, who had necessarily sent their exhibits several thousand miles, and whose interests were in most cases less fully represented than was the case with native makers.

Philadelphian system of awards.

Inferior exhibits officially ignored.

According to the system adopted for the first time in its entirety at this exhibition, each award was to be accompanied by a short report, giving the reasons for granting the prize. If these could have been shown either by stating the exact figures of merit, or even citing by name, and "grading" in this way—as they say in America,—at the same time pointing out the unsuccessful machines, results most instructive to the public would have been arrived at. On the other hand, such figures would have been most displeasing and injurious to the unsuccessful competitors; and we were expressly requested by the Executive Commission to ignore the ruck in the race. But it is perhaps not too much to say that, if such an ideal could be carried out, if a competent and in every way satisfactory board of judges could give sufficient time to so great a work, a point of departure, an era in the arts, would be arrived at. One further important qualification would be the relative price of each machine. But, in America especially, the actual prices are so masked, as it were, by the existence of certain patents, the prices are so much controlled by this cause that, especially with the sewing machines, the qualifications of relative cheapness could not fairly be taken into consideration. The point, however, the most carefully considered in apportioning the awards, was the quality and quantity of work done, the quality more especially; and in no instance, except in some of the foreign exhibits, where, in the absence of the exhibitors, the machines could not be tested, was any award given to a machine that had not been carefully tried. We believe that in but few, if any, instances were machines specially made for exhibition. No doubt to many was given an extra outside finish; but this did not affect the actual working; and if makers lacked the knowledge necessary to properly time the motions of their machines intended for sale, they also lacked it in building their exhibition machines, as, indeed, our trials in many cases soon found out. At least one of the machines, however, for which special claims were advanced for easy running, obtained this easy running by the simple process of speeding down the gear, as clearly resulted from our measurements of the band wheels. The Philadelphia Exhibition formed perhaps the only occasion on which such a long series of this class of machines was submitted to careful practical trials. This, where it can be carried out, affords the only sound basis for a distribution of awards; in the face of the very eager competition between the different makers, of the sewing machines more especially, it gave the only means of balancing their relative merits, and of discriminating pretenders whose machines might find a more or less extensive sale, but could scarcely stand the microscopic examination of experts. By these trials we have attempted, in combination with the reports given with each medal, to encourage machines really useful to the public, and to set up finger posts of some use to non-mechanical purchasers. On the other hand, it was clearly impossible for us to consider for awards mere copies of American or other models, however well made, and working however well; in spite of the fact that such makers avowedly sent them to America for competition. As one instance of an unreasonable expectation, we may mention that one foreign exhibitor actually sent three different machines, by different American makers, which he had merely repaired, and for the mere repairing of which he expected an award.

Results important if system fully carried out.

Why prices not considered.

Most machines set to work by Group XXII.

Group XXII. aimed at obtaining results useful to public.

Mere copies not considered for awards.

Sewing machines.

Large production in the United States.

Of course sewing machines took the first rank in number, commercial importance, and, as natural consequences, in the consummate ingenuity and enterprise of their makers. As naturally, too, the United States took in this department the first rank. The yearly production of sewing machines in the States of the Union alone is at least 500,000; it is probably more, and is annually increasing. During the last 25 years, one single firm has made and sold the almost incredible number of 2,000,000. America was notoriously pre-eminent in sewing machines at both the World's shows of 1867 in Paris, and 1873 in Vienna, most exhibits in this class being either of American manufacture or design. At Vienna, the United States in fact made in everything else but sewing machines a comparatively poor show. On her own ground, therefore, much was to be expected; and, accordingly, the exhibition of sewing

machines at Philadelphia surpassed in quantity and quality, whether in variety or novelty of design, anything of the kind the world has yet seen. The occasion was also seized by many of the leading and other manufacturers of making this exhibition a point of departure, so to say, for quite new and improved forms of their machinery.

Important Show at Philadelphia.

The competition amongst the American manufacturers is so great, the American public, technical or otherwise, are such good judges of labour-saving machinery, that only by the most strenuous exertions can the competitors keep up in a race wherein to lag behind is ruin. All the great makers keep one, often two highly skilled and trained machinists, at very high salaries, constantly and solely employed in experimenting on new devices intended to keep the given machine ahead of all others. Many of these improvements are only brought before the public after years of careful experimenting. Some of the inventors employed by the great manufacturers to give their sole energies to improving their machines are paid at the rate of $10,000 and more per annum; and a machine was pointed out to us, an improved modification of an instrument of world-wide fame, that was said to have cost $250,000 to bring it up to its present pitch of perfection.

Enterprise of American makers.

Continuous progress made by them.

It is expected that, in the course of the next year, 1877, the prices of American sewing machines will fall very considerably. This is the date of the expiration of the Bachelder patent, which has actually been prolonged by the Congress of the United States for two terms, in all 28 years. This patent,—merely for the substitution of a continuous spiked band for a plate of unlimited length,—still forms the bond of union in the combination between certain of the great American makers; and with the expiration of this patent, this contract will also expire. Whether, however, the prices will really be very much reduced is perhaps a question. The expenses of a sewing machine maker do not, as in the case of all other machinery, cease with the sale of the article. He must give full and often lengthy instructions to the buyer, in order that the working of the machine be thoroughly mastered, and this involves heavy cost, whether in the form of agents' commissions, or the salaries of skilled operators. The sewing machine trade is also very largely based upon long credits to people unable to pay on delivery. There is then another fact to be considered. The leading firms, such as Messrs. Singer, Messrs. Wheeler and Wilson, Wilcox and Gibbs, and Weed, make the details of their machines on the interchangeable or duplicate system, by means of special self-acting workshop tools, in the same way as all small arms are manufactured. The machines can thereby be put together with a minimum expenditure of time and money; and the interchangeable parts be at once cheaply replaced when worn or otherwise damaged. The work in the foundry is thus done by moulding machines, and the castings cleaned by machinery; the wrought-iron parts are "drop-forgings," blanks being wrought into shape, often at one blow, in dies and matrices; while milling-machines, similar to those used in the manufacture of small-arms, are employed to finish the details. The results of this system are, especially as regards renewal, of very great value to the buyer, and the sources of great savings to the maker; but the system also means the locking up a very heavy capital in machinery and plant. What, therefore, with the necessity for making interchangeable work, with the very heavy attendant cost in plant, and the peculiar mode of sale adopted, the times are long past when the manufacture of sewing machines could be undertaken on a small scale. Hence the element of competition will always be greatly lacking in the manufacture of sewing machines unless some revolutionary invention be manufactured by an outsider; and the manufacture year by year shows a greater tendency to be confined to a few great firms.

Prices of sewing machines.

Manufactured on Interchangeable plan.

The following table gives the tests we adopted for the family machines :—

Working tests adopted by Group XXII.

No. 1. Seam on two thicknesses of fine white cambric, with No. 300 cotton.

No. 2. Seam on two thicknesses of fine white tarleton, with No. 300 cotton.

No. 3. Seam on two thicknesses of fine white linen, with No. 150 cotton.

No. 4. Seam on two thicknesses of common muslin, with No. 70 cotton.

No. 5. Seam on two thicknesses of coloured duck, with No. 24 cotton.
No. 6. Seam on 8, and then 16 thicknesses, of coloured duck, with No. 24 cotton.
No. 7. Seam on two thicknesses heavy beaver cloth, with No. 80 three cord black linen.
No. 8. Seam on six thicknesses heavy beaver cloth, with No. 35 three cord black linen.
No. 9. Sample of seam on two thicknesses fine black cloth, with No. 000 black machine silk.
No. 10. Sample of seam on two thicknesses, prunella, with No. 0 black machine silk.
No. 11. Sample of seam on black lasting, with No. 0 black silk.
No. 12. With the lasting and prunella, with No. 0 black machine silk.

The tests for manufacturing machines for cloth work were:
No. 1. Sample of stitching on two thicknesses cloth, with 000 machine twist.
No. 2. Sample of stitching on ten and twenty thicknesses of cloth, with No. 35 three cord linen thread.

For manufacturing machines for stitching red and morocco leather of one and three thicknesses:
No. 1. Sample of ornamental stitching on patent leather and calf skin, with No. 000 White Twist.
No. 2. Sample of seaming on two thicknesses calf skin, C. twist.
No. 3. Sample of closing, D twist with black thread.

These tests very complete.

It will be observed that these tests range from very delicate to work very heavy indeed. That a few, very few, it is true, were able to pass the ordeal successfully is a proof that, in spite of the complaints of unsuccessful competitors, they were not unduly severe; and it could fairly be assumed that any machine whatever putting itself forward for competition could sew perfectly well with ordinary threads and fabrics. Speed of working, as measured by a counter, was also tested and taken into account. Indeed, if all the machines exhibited had been connected with steam power, and tried under ordinary work at the highest possible speeds, this in itself would have formed an excellent test of the timeing together of the different parts, and of the working of each machine.

Bias work.

Bias work was not done in order to prove the elasticity of the stitch, nor was any dynamometer applied to the machines. Some, however, such as the new No. 8. machine of Messrs. Wheeler and Wilson, and the new Weed machines, were tested as to easy working, by actually driving them with a loop of No. 70 cotton, which replaced the usual leather band.

The Singer machines.

As might fairly be expected, the family machine of the Singer Manufacturing Company worked well. This is well known as a shuttle sewing machine embodying a needle bar operated directly from the end of a rotating shaft in the overhanging arm, a shuttle supported in a shuttle carrier moved transversely to the feed by means of a crank on a rotating shaft, a four-motioned positive feed, and a straight needle with its eye parallel with the direction of the feed. All the motions of this machine are what is termed in America, "positive;" that is to say, they are directly effected by mechanical parts, and are not dependent for their action upon springs. It accordingly obtained an award with a full report. But few, and those only slight, changes have been made of late by this firm in the construction of their machinery. But their exhibits, contained within a separate handsome building, were noteworthy for very great variety. This company showed a machine for shoe work, a special machine for cloth, a large shuttle machine for stitching harness, saddles, and carriage trimming; a similar one for stitching bag handles, and another for sewing material that cannot be rolled to pass under the arm of the machine; a wax-thread machine for coarse boots, brogues, harness, and all work requiring a waxed thread, a medium machine with two needles for sewing two parallel seams at same time, a small shuttle machine with automatic binder for soft hats, another with binder for cap fronts, another small shuttle machine for stitching bugle fronts, and yet another with automatic rim-gauge. The sewing machine attachments exhibited by the Singer Company consisted in a band attachment, an adjustable binder, a shoe binder, a

Great variety of exhibits of that company.

corder, a tuck worker, with self-adjusting notch and point, an embroiderer, a trimmer, a ruffler, a quilter with double adjusting guides, an upper and under braider in combination, an automatic hemmer and trimmer combined, and a trimming knife for shoe-work. This is the firm which has already sold two million machines; and not less than 6,500 agents, merely for effecting sales in all parts of the world, are in their employ. It is also an evidence of the approval of the public that at least six different makers from England, Germany, Belgium, Sweden, sent direct copies of, apparently for competition with, the parent machine. And yet this enormous enterprise is said to have been originally started on a capital of forty dollars.

Singer machine often copied.

Of all the machines we tested, the Wheeler and Wilson *new* machine was the most completely successful, failing in nothing that was given to it. The beauty of its stitch, especially on leather, was unsurpassed; and it obtained a second award "for superior quality of work in leather stitching." The new Wheeler and Wilson machine may be defined as one making a lock-stitch and employing a straight needle moved by a vibrating arm and grooved cam; also a disc bobbin and a rotating hook, the latter having a varying speed of rotation by means of a divided shaft with connecting disc. The original features in the old Wheeler and Wilson machine were the rotary hook and bobbin, forming practically a revolving, in contradistinction to the reciprocating, shuttle, and the four-motion feed. The defective curved needle, inherently weak and wrong in principle, formerly used, has now been superseded by a straight needle; while the varying speed of rotation of the rotary hook and bobbin brings the machine as close to perfection in timing the parts to their work as is perhaps possible. In their own words, the company claim, "(1.) The originality of the device for producing the variable velocity of the "hook; (2.) The originality of the independent take-up, which, by positive "motions, gives thread just when needed by the movements of the hook, and "does not begin to draw up the loop until the needle is entirely out of the "goods, thus permitting the use of larger thread with smaller needle than is "otherwise possible, preventing the chafing or fraying of the thread between "the needle and the material sewed, filling the needle hole with thread, pro-"ducing a water-tight seam in waterproof goods, and giving a beauty and "strength to the stitch which is otherwise unattainable; (3.) The originality "of the under tension apparatus, which clamps the lower thread only while "the take-up is closing the stitch, and releases it entirely as soon as the "drawing up is completed, so that there is no tension on the lower thread "while the process of feeding is going on; which requires no 'threading up,' "and may be regulated to give the required tension, while the machine is in "operation, by simply moving a lever, and is so peculiarly constructed that "knots, loops, or varying size of under thread cause no obstruction to the "process of sewing. This tension apparatus was patented as an automatic "tension, and it is automatic not simply in this, that of its own action it "necessarily clamps and releases the thread at precisely the right time, but "such are its relations to feed, take-up, and upper tension, as to render the "entire tension apparatus of the machine automatic in this respect, that when "the tensions are once properly 'balanced,'—*i.e.*, adjusted as to relative "intensity—the position of the lock of the stitch in the goods is independent "of the length of stitch, or the kind or thickness of the material sewed."

The Wheeler and Wilson machine.

Another very important machine, and showing recent improvements, is that of Messrs. Willcox and Gibbs. It employs a straight needle and a rotating hook with single thread, to form a chain or loopstitch. Some seamstresses complain that this stitch is too easily unravelled, and, in any case, that it uses up more thread than the ordinary lockstitch machine. The first objection is sometimes overcome by sewing two parallel seams. This is the most rapidly running of all, when driven by power making the almost incredible number of 3,000 stitches per minute. It also runs with remarkable ease, and is hence sometimes preferred by seamstresses who object to machines requiring more physical exertion. The most important and original feature in the new Willcox and Gibbs sewing machine consists in the automatic tension, by the use of which no change in the machine is required to meet any variation in the stitch, thread, or goods. The thread by means of a simple self-acting arrangement is released at the very instant of time required, and is then held tight for the remainder of the stitch. The stitch adjustment can be set by merely moving "the stitch regulator" until

The Willcox and Gibbs machine.

Chainstitch.

Automatic tension.

numerals showing the exact number of stitches to an inch appear through a slot in the cloth plate; and against a corresponding number engraved on a table on the cloth plate appear the numbers giving the appropriate sizes of needle and thread. There are thus no haphazard preliminary trials on the part of the seamstress. Apart from the Grover and Baker double chainstitch machine, this is thus the only commercial machine solely making any other than the now universally used lockstitch. And even this firm are said to be experimenting with a machine for forming this stitch, which is no doubt the best of all as regards security from unravelling, evenness on both sides, freedom from a ridge, and economy in thread. This machine Messrs. Willcox and Gibbs are stated to be keeping *in petto* until fully perfected; so that, although patented in the United States, it was not to be seen at the Centennial Exhibition.

Double chain-stitch.

Lockstitch best of all.

The Weed machine.

Another new machine which obtained a medal and favourable report was that of the Weed Sewing Machine Company, of Hartford, Connecticut. This is a shuttle machine, employing a straight needle and needle bar, connected by a link with a crank at the end of a horizontal shaft in the overhanging arm. The needle bar moving shaft is connected through a link with, and has a working motion imparted to it by, a crank on a lower rotating shaft. The shuttle set in a carrier is reciprocated parallel with the direction of the feed by a crank and link connected with the rotating shaft, and the four-motioned feed is moved positively. The details of this new Weed machine must undoubtedly wear well, and they are of very great merit, while the work it did was excellent. The Howe is a shuttle machine in which both needle and shuttle are moved by means of vibrating levers actuated by grooved hub cams on a rotating shaft. As this machine did good work, it obtained an award, but we consider that in point of constructive merit, involving long wear, it is much surpassed by many machines of inferior fame. It worked especially well on leather, for which the draw of the threads, and the sensitive shuttle tension, well adapt it. A machine that also did good work was that of the Wilson Sewing Machine Company, Chicago. This is a shuttle machine employing a shuttle reciprocated transversely to the feeding movement of the four-motioned feed; with a straight needle and needle bar moved by a vibrating arm, and actuated by a crank pin working in a heart-shaped cam made in the lower end of the vibrating arm below the cloth support. The following machines also obtained awards. Messrs. J. and W. Lyall, of New York, showed the most rapidly-working shuttle machine on the ground, the invention of Mr. Whitehill. It was timed by the judges up to 2,200 stitches per minute. The vertical needle-bar is reciprocated from a rotating shaft by an epicycloidal movement. Messrs. Johnson, Clark, and Co.'s so-called "Home" hand-operated shuttle machine, employing a straight needle bar operated by a rotating shaft and heart cam, a horizontally vibrating shuttle carrying arm moved by an eccentric on a horizontal shaft is one of the few machines of this class, hand machines not having been as yet much introduced into the United States. Their slower action is not liked. In England they are much in use in households, and are preferred on account of their portability. The Davis Sewing Machine Company of Watertown, New York, obtained an award for their shuttle sewing machine, employing a co-operating vertical upper and needle feed and lifting presser, and a shuttle supported in a carrier at the end of a horizontally vibrating arm actuated from a vertical lever operated by a cam on a rotating shaft in the overhanging arm. The Howe Company also showed machines for ornamental stitching on fine shoes, gloves, and similar work, having a universal feed operated automatically by means of a Jacquard movement or by hand, and capable of producing designs in great variety. The Coles embroidery machine, the Goodes' machine, are similar in general character, being adaptable to ordinary work. As a rule, however, we did not find that these machines did their ordinary work at all well. Some machines on the well-known Grover and Baker, or double chain stitch plan, were shown by the "Domestic" Sewing Machine Company. This machine is now getting entirely out of use in America for family and manufacturing purposes. Except for uses wherein peculiar elasticity of stitch is required, such as for shot bags, or wherein its stitch is used for ornamental purposes, it is not now bought by the very discriminating and shrewd American public, who object to the great amount of thread taken up by this form of stitch. The most practical

The Howe machine.

The Wilson machine.

Sundry sewing machines.

Hand machines not liked in the States.

Embroidering, &c. machines.

Machines for doing both embroidery and ordinary work.

The Grover and Baker Machine.

Shot bags sewn with double chainstitch.

mode of doing embroidery and similar work on a machine to be used for ordinary work also is to adapt to it one of the many separate embroidery attachments now in the market. But for a lady, in contradistinction to a working seamstress, comparatively indifferent as to the consumption of time and thread, desirous of a very elastic stitch and of the capability of easily making ornamental work, perhaps the Grover and Baker is the most suitable machine. A different case is that wherein embroidery work has to be done solely and rapidly in manufacturing establishments. France showed the really beautiful Bonnaz embroidering machine, admirable for the ingenuity displayed in its combination, and for its excellent workmanship. It was exhibited by E. Cornely, of Paris. It it well known by this time in England; with its hooked needle, and its universal upper four-motioned feed. It is stated to work with any kind of thread, from the finest cotton to chenille, on any material from the lightest tulle to the heaviest cloth; and it very deservedly obtained a premium. France sent no sewing machines, only a peculiar form of treadle adaptable to such machinery. Of the European sewing machines which obtained awards we may mention those by Messrs. Kimball and Morton, of Glasgow and Dundee; the first was a large shuttle machine for sewing sails, bagging, and tarpaulins. The head in which the needle bar reciprocates is moved laterally after each stitch, so as to make the herring-bone stitch; the needle bar is operated by a rotating shaft and heart cam, the feed surface is placed above the material, it has four motions, and the shuttle is moved transversely to the direction of the feed. The second was a sewing machine having a peculiar thread-carrying looper attached to a shuttle driver, and adapted to form an overseaming stitch. Messrs. R. M. Wanzer & Co., of Ontario, were awarded a medal for a shuttle sewing machine, employing a rotating shaft, with overhanging arm, and driving the needle bar through a link and trammel movement, placed eccentrically to the disc at the end of the shaft, and a shuttle moved parallel with the direction of the feed by a crank on a rocking shaft, and a four motioned feed. The only exhibit in this class from Denmark was sent by H. Henriksen, of Copenhagen. It consisted in a small machine for sewing gloves with a lock stitch, and having a flat and a tubular work support. It obtained an award on account of its fair amount of originality. The treadle in the machine of Messrs. Wilkie and Osborne, Guelph, Ont., is suspended in such wise that the foot-rest may be moved and held at different angles, so that the operator can alter the position of her feet and bring into action different sets of muscles. A medal was given for this treadle, not for the machine. The friction belt gearing for obtaining varying speeds on sewing machines, by Mr. Howard of Philadelphia, is well suited for power-driven machines having to be frequently stopped and varied in speed. A pair of light stands screwed to the floor carry a shaft to which an adjustable treadle is attached, as also an arm to which are secured a light case and belt guide, carrying the belt pulley. The belt is passed round this pulley up to that on the machine, adjusted so that the belt will hold it out of contact with the pulley on line shaft. A slight pressure of the foot will thus start the machine slowly, the speed increasing with the pressure on the treadle. Eickemeyer's Hat-blocking Machine Company, of Yonkers, New York, got a medal for their machine for sewing sweat linings in hats. It is made with a supporting plate, set to an acute angle, for sustaining the hat, the brim being allowed to project over the edge of the support. The stitching mechanism consists of an eye-pointed needle and vibrating looper to form a chain stitch. The machine for sewing "green" hides, such as sheep-skins, together, before tanning them, by Mr. G. C. Walters, of Philadelphia, obtained an award. The machine makes a chain-stitch, and the skin is held and fed onwards between the serrated presser foot and a serrated bottom holder. The clamping jaws thus formed are caused to oscillate together, the presser foot being drawn up again for the return, and the needle passes up and down through a slot in both. Of this class may also be noted a machine for sewing untanned goat skins, and another for untanned salted sheep skins, by Geo. Wm. Baker, of Wilmington, Del.

Double chain-stitch machine perhaps best for a lady.

The Bonnaz embroidering machine.

Sundry sewing machines. Kimball and Morton, Glasgow.

The Wanzer Machine.

Glove Machine. H. Henriksen, Copenhagen.

Treadle. Wilkie and Osborne, Guelph, Ont.

Varying speed belting. Mr. Howard, Philadelphia.

Eickemeyer's Hat-blocking Co., New York.

Machines for sewing "green" hides. Mr. G. C. Walters, Philadelphia.

Mr. G. W. Baker, Wilmington, Del.

Button-hole sewing machines form important adjuncts to large tailoring and similar establishments; they embody a great deal of ingenuity. Four were medalled by the judges. The Singer button-hole machine is specially adapted for making button-holes in clothing and leather, the materials to be

Button-hole sewing machines. Singer Machine.

stitched being held in an automatically moving clamp that presents the edge of the button-hole to the action of a needle reciprocating in a laterally moving head.

American Button-hole Co., Philadelphia.

The button-hole machine of the American Button-hole Overseaming and Sewing Machine Company employs a straight needle actuated through a vibrating arm and cam-grooved hub, and a curved shuttle reciprocated in a plane parallel with the feed on a curved race way. For button-hole stitching the shuttle race is turned aside, a vibrating arm provided with a curved thread carrying looper is turned into working position so as to carry its thread through the loop of needle thread and above the edge of the material to be acted upon by a loop spreader. The award also covered a carpet sewing machine.

Remington Sewing Machine Co., Ilion, N.Y.

The Remington Sewing Machine Company obtained an award on a button-hole sewing machine specially for cotton and linen, employing a single thread, and finishing the button-hole automatically. This was constructed according to Mr. Cleminshaw's patents; and it is a very ingenious machine.

Mr. Cleminshaw's patents.

Hamburgh-American Sewing Machine.

The Hamburgh-American Sewing Machine Company, formerly Messrs. Pollack, Schmidt, & Co., sent other work besides mere copies of the leading American makers. For their button-hole sewing machine with vibrating arm and a shuttle they obtained an award. The guide for the needle-bar is set to one side of the machine, and is suspended from and oscillates on a pin in the head of the machine. When the machine is to be used for an ordinary stitch, the oscillating guide is held by a catch, on being unlocked it can be vibrated to and fro by means of a face cam acting on a lever, and a link pinned thereto. Messrs. Pollack and Schmidt were also at Vienna, where they exhibited machines on the old Wheeler and Wilson, and on the Wilcox and Gibbs systems.

Curved needles inherently defective.

It is now generally acknowledged, tacitly or otherwise, that machines employing curved needles are only practicable for very light work. The sole machine in the Exhibition with a curved needle, after doing fairly well some light work, broke down lamentably on a heavier class of goods.

Two spool machines.

We may also note that the two spool sewing machines, two of which were fully tried, were not found to stand the tests well, either for light or heavy work.

Sewing machine attachments.

As regards sewing machine attachments, no medal was given for the reason that the principal makers of the best sewing machine attachments did not appear in person; according to the rules, exhibitors of other peoples' products could not be noticed; while it was preferred to ignore anything second-rate.

Drop forgings. Billings and Spencer Co., Hartford, Conn.

The Billings and Spencer Company, Connecticut, showed a number of drop forged and cold pressed sewing machine shuttles, and shuttle bobbins. These articles are drop forged out of steel, cold pressed under heavy pressure, and then finished merely on an emery wheel, thus saving the expense of milling. By this employment of Mr. Billings' patented plan, the surfaces are said to be made harder against wear, and the whole piece tougher.

Needle-making machines. National Needle Co., Springfield, Mass.

The National Needle Company, Springfield, Massachusetts, obtained a medal for their needles and system of making them. Employed in manufacturing sewing machine needles, their set of fine machinery sucessfully carried on the operations of reducing and printing, polishing, grooving, eye punching, leather pointing, tempering, hard burring, brass brushing, eye polishing, hand straightening, and giving the finishing points and final polish.

Needles.

H. Millward & Son, Redditch.

James Smith & Son, Astwood Bank.

John Wright Smith, Leicester.

Leo Lammertz, Aix-la-Chapelle.

Messrs. H. Millward and Son of Redditch, James Smith and Son, Astwood Bank, and John Wright Smith of Leicester, were the English needle making firms who obtained medals for their exhibits. Herr Lammertz of Aix-la-Chapelle obtained a medal for a first-rate display of sewing machine needles, distinguished for their well polished eyes and good temper. Mrs. Suplee, of the Suplee Needle Co., New York, obtained a medal for an open-eyed needle easily threaded without reeving by persons with defective sight, as the eye is opened with a side cut, past which the thread can be slipped into the eye.

Motors.

Numerous sewing machine prime movers were on exhibition, such as Backus' water motor, Haskell's reciprocating water engine, several electro-magnetic engines, such as Hussey's, some very small steam engines, and a "minimotor," consisting of a small form of Ryder's hot-air compression engine. But these did not, it was ascertained later on, officially come under our notice, being considered by the group of judges on motors.

Knitting machines. Lamb Knitting Machine Co.,

We now come to the knitting machines that gained prizes. The Lamb Knitting Machine Manufacturing Company, of Chicopee Falls, received a medal for two machines; their knitting machine for family use employing two

Chicopee Falls, Mass. — **Franz & Pope, Knitting Machine Co., Bucyrus, Ohio.** — **Mr. Dana Bickford, New York.** — **Messrs. Campbell and Clute's, Cohoes, N.Y.** — **Messrs. Gimson and Coltman, Leicester.**

rows of latched needles adapted to be used separately or together for flat or circular fabrics, if desired; and for a straight machine for knitting ribbed fabrics for Cardigan jackets. The Franz and Pope Knitting Machine Company, Bucyrus, Ohio, obtained a medal for the original point in their circular knitting machine, which consists in its constructive capability to remove needles or place them in position to be gradually moved into or out of action for producing heels in hosiery fabrics and to knit goods. This was also the case with Mr. Dana Bickford, of New York, and for his circular automatically reversible knitting machine, for knitting tubular or flat web, complete stockings or socks, and other fancy or plain work. This is, we believe, the machine advertised in England under the designation of the "little Rapid;" and its leading feature of originality consists in its mechanism for reversing the cam cylinder to enable this circular machine to produce tubular or flat fabric. Messrs. Campbell and Clute's upright rotary knitting machine, using bearded needles, obtained an award for its excellent attachment to prevent the work from running off the needles when the thread breaks, and for its good automatic self-regulating take-up. The circular ribbing machine for heavy work, adapted to make tubular goods with polka or plain rib stitch, exhibited by Messrs. Gimson and Coltman of Leicester, obtained an award.

Cloth-cutting machines. — **Mr. Sanson, London.** — **Cloth-folding machine. Mr. Albin Worth, Staten Island, New York.**

The only cloth-cutting machine of the three exhibited which obtained a medal was that of Mr. Sanson of London, all three having been very carefully tested. This machine is simply a common band saw or rather band knife, the upper arm of the frame being made to spring slightly in order to prevent its running hard. The folds of cloth are necessarily moved against the band just as a piece of wood is moved against the band saw. In the two American machines, on the contrary, in the one case a rotary cutting head, in the other a reciprocating knife, is combined with a travelling power carrier; and the tool, held by the operator, is moved along the contours of the cloth to be cut out. Mr. Albin Worth, of Staten Island, New York, obtained a medal for his travelling cloth-folding and measuring machine, by which the material can be piled in layers of any length for the marking of the design to be cut; and the machine can be reversed in such wise that fine goods can be laid so as to be cut off to any length.

Pressing machines. Mr. Storrs, Canton, N.Y. — **Mr. Sanson, London.** — **Mr. W. B. Walker, Boston, Mass.**

Of the pressing machines for tailors' use, that of Mr. Storrs, of Canton, N.Y., obtained an award. Its pressing iron is free to be turned in any direction at the end of an arm connected by a pivoted link with the upper end of a]-shaped arm supported on a horizontal bearing. This]-shaped arm is provided with a foot lever for moving it so as to press the "goose" down upon the material with any desired degree of pressure, the material being suitably arranged on the press board. The arm is moved by hand, and heated by means of a hot iron plate inserted within the hollow iron. In the pressing machine by Mr. Sanson, of London, the iron may be partially revolved at the end of a rod adapted to slide longitudinally between a number of rollers carried on a pivoted arm or crane, free to be moved in the arc of a circle. In that of Mr. Walker of Boston, Mass., the iron is swivelled at the end of a toggle free to turn about a vertical shaft, adapted to be raised or lowered by the action of a spring and foot lever, so as to press it down with sufficient force. The iron is moved by hand, and is warmed by the insertion of a heated plate.

Watch-making machines. Waltham Watch Co. — **Mr. Stark, Waltham, Mass.** — **Messrs. Louis Borel Petitpierre, Neuchâtel.** — **Messrs. Samuel Vautier & Son.**

Foremost amongst the exhibitors of watch-making machinery, the American Watch Company, Waltham, Mass., obtained one medal as being the first firm to adopt the system of assembling interchangeable parts in the manufacture of watches, and a second for their watch machinery itself. A lengthy and important treatise could be compiled on the American factory method of making watches, especially as contrasted with the Swiss house and hand system. An ingenious combination lathe, of which some 5,000 are said to be in use, for making and repairing parts of watches, by Mr. Stark, Waltham, Mass., obtained an award. This was also the case with Messrs. Louis Borel Petitpierre of Neuchâtel, Switzerland, for their watchmakers' lathes and machines for the hand systems of watchmaking and repairing; and Messrs. Samuel Vautier and Son, for files, gravers, and burnishers used in watchmaking and jewellery.

Braiding machines, &c. Butler Braider Co., Clinton, Mass. — **Machines for sticking pins.**

Amongst the miscellaneous class of machinery which obtained awards were the machines of the Butler Braider Company, Clinton, Mass., who showed at work six braiding machines, four carrying 53 threads, one 17, and one 16 threads. The so-called Pyramid Pin Company had a series of ingenious

Pyramid Pin Co., New Haven, Conn.
Mr. Oppenheimer, Philadelphia.
Herr Schmalz, Altenburg, Saxony.

machines for sticking pins into a continuous strip of paper, afterwards wound and pressed into a conical form. Mr. Oppenheimer, of Philadelphia, used hollow metal conical tubes, supplied with steam or hot water for curling real and imitation hair goods. Herr Schmalz, of Altenburg, Saxony, obtained a medal for a very complete display of stamps and dies used in the manufacture of gloves. A novel machine for darning stockings and clothing is made by the Pope Manufacturing Company, Boston, and it is being introduced into England. The fabric is held in blocks corrugating it temporarily in such wise that a series of needles held on a reciprocating bar can pass through and through the margins of the hole in the fabric. These needles, which are eye-pointed, move in grooves in the block, and when passed through the fabric, are then all threaded by the same thread. This thread is then drawn out in loops from between each needle and each loop, is placed on a pin of a loop holder adjustable to or from the work holding blocks to adapt the loop to the size of the hole, and on the return movement of the needle bar each needle draws a doubled loop through the fabric at each side of, and leaves the thread extended across, the hole. The loops of thread are then cut at the eyes of the needles, and the fabric is turned on the holding blocks and clamped, so that the needles in their next movement will draw the loops then formed across and interweave them with the loops of thread previously laid by the needles. This machine is very simple, and probably has a great future before it; but at present the edges of the darn are left somewhat rough, and the apparatus—it can scarcely be called a machine—is capable of improvement.

Darning machine.
Pope Manufacturing Co., Boston, Mass.

Pre-eminence of United States in these classes.

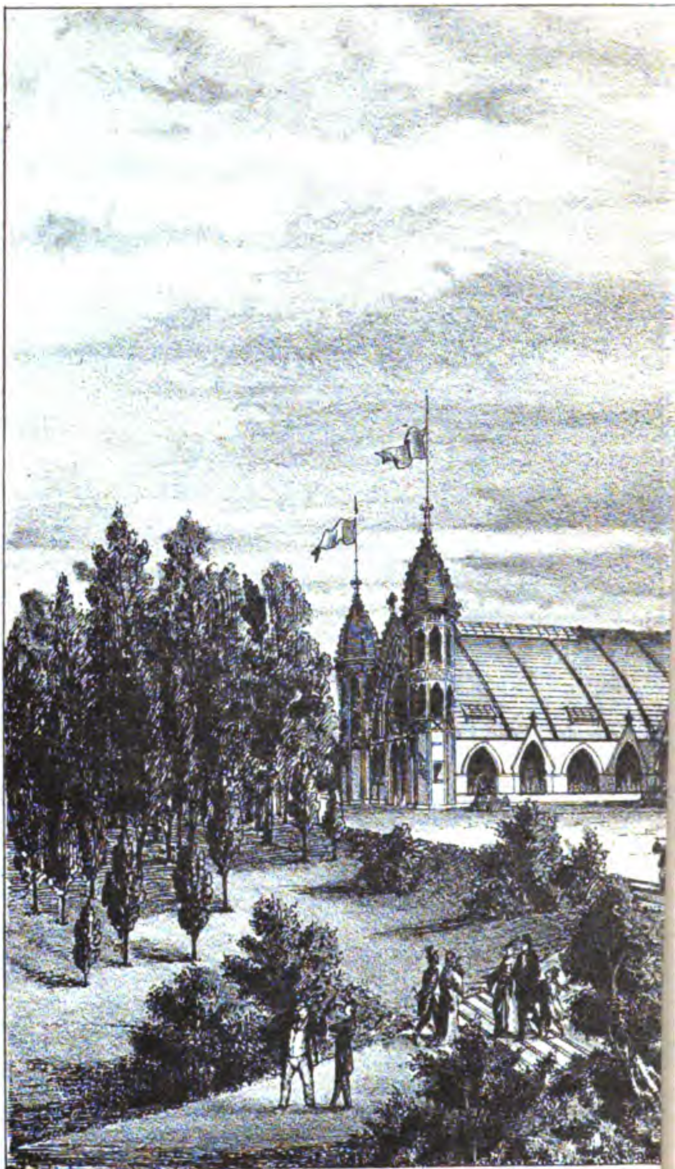
In conclusion, it may be remarked, that perhaps no mechanic could examine the exhibits of this group more especially without coming to the conclusion that in the production of this class of labour and skill-saving machinery the United States stand pre-eminent.

Since the above report was written, the United States Executive Commission created a Jury of Appeals, by whom a few additional awards have been granted, but of which the writer has not received official intimation.

FREDK. AR. PAGET.

Colonel H. B. Sandford,
British Executive Commission, Philadelphia.

Digitized by Google



JAMES H WINDRIM, ARCHITECT

Area - 117,760 sq. ft

IN

FAIRMOUNT PARK

Mr. JOHN COLEMAN.

AGRICULTURAL MACHINERY.

Report on Agricultural Machinery shown at the International Exhibition, Philadelphia, 1876.

By John Coleman, Esq.

Sir,

Before entering upon a short account of the Agricultural Machinery at the International Exhibition at Philadelphia, it may be as well to observe that the Work of the Judges and the System of Awards differed materially from previous Exhibitions, the large International Jury being replaced by 250 judges, half foreigners and half citizens of the United States, divided into numerous Groups of varying strength according to the extent of the display under each particular head. The work of the judges was to examine and report upon such Exhibits as they considered worthy of award; the reports to be based upon inherent and comparative merit; the elements of merit to include considerations relating to originality, invention, discovery, utility, quality, skill, workmanship, fitness for the purposes intended, adaptation to public wants, economy, and cost. Each Report was attested by the signature of the reporting judge, confirmed by those of his colleagues; the Awards, which comprise a uniform Medal accompanied by the report, to be finally declared by the United States Centennial Commission.

System of Awards and work of Judges.

Basis of Reports.

It is evident that the value of this arrangement would mainly depend upon the ability and care exercised upon the reports. We are inclined to believe that the Reports, as regards many of the Groups, will prove of more value to Exhibitors than graduated Medals without such explanations. Each Exhibitor will have the right to reproduce and publish the Report awarded to him; the Centennial Commission reserving the right to publish and dispose of all reports in the manner it thinks best for public information, and also to embody and distribute the reports as records of the Exhibition. In addition to the reports upon individual exhibits, the Judges of each group were required to furnish a general report of the collective exhibition under their charge, embracing some notice of the early history, progress, and present condition of the different industries. Whatever may be the comparative advantage of this over previous arrangements, and I am inclined to think it will be considerable, there can be no doubt as to the additional and severe labour which it entailed upon the judges—a labour which was cheerfully undertaken and carried out with zeal. At Vienna the number of the International Jury reached 600; whereas at Philadelphia the work was divided, as has been before mentioned, amongst 250 judges, of whom England supplied 18.

Value of Reports to each individual Exhibitor.

General Report by Judges of each group.

Vienna International Jury, 600. Philadelphia Judges, 250.

Group No. XXIII. on Agricultural Machinery, of which I had the honour to be appointed chairman, originally comprised the following members:—

Judges' Group, No. XXIII.

John Coleman (Chairman) - -	England.
J. S. Grinnell (Secretary) - -	Washington, D.C.
Hon. J. P. Reynolds - - -	Chicago, Illinois.
James Bruce - - - -	Carvallos, Oregon.
P. Paes Lème - - - -	Brazil.
Firman Rosillo - - - -	Spain.

The Hon. J. P. Reynolds being obliged to leave after a short attendance, and Mr. Grinnell having to retire on account of ill-health, the Committee obtained the valuable services of Mr. F. Oldendorff (Chief Commissioner of the Argentine Republic), who was transferred from Group No. 4 (Animal and Vegetable Products), and they were afterwards joined by Mr. Ekeda Kenzo, a member of the Japanese Commission, who was also originally attached to No. 4 group.

The following synopsis will afford some idea of the variety of the objects on which the Committee had to adjudicate:—

Synopsis of specific objects.

Class 670.—Tillage:

Manual implements:—Spades, Hoes, Rakes. Animal-power Machinery: Ploughs, Cultivators, Horse-hoes, Clod-crushers, Rollers, Harrows. Steam-power Machinery: Ploughs, Breakers, Harrows, Cultivators.

Class 671.—PLANTING:

Manual implements:—Corn Planters and Hand Drills. Animal-power Machinery: Grain and Manure Drills, Corn and Cotton Planters. Steam-power Machinery: Grain and Manure Drills.

Class 672.—HARVESTING:

Manual implements:—Grain Cradles, Sickles, Reaping-hooks. Animal-power Machinery: Reapers and Headers, Mowers, Tedders, Rakes, Hay Elevators and Hay Loaders, Potato Diggers.

Class 673.—PREPARATORY TO MARKET:

Thrashers, Clover Hullers, Corn Shellers, Winnowers, Haymaking Apparatus.

Class 674.—APPLICABLE TO FARM ECONOMY:

Portable and Stationary Engines, Chaffers, Hay and Seed Cutters, Slicers, Pulpers, Corn Mills, Farm Boilers, and Steamers, Incubators.

Class 675.—DAIRY FITTINGS AND APPLIANCES:

Churns for hand and power, Butter Workers, Cans and Pails, Cheese Presses, Vats, and Apparatus.

Class 680.—LAYING OUT AND IMPROVING FARMS:

Clearing,—Stump Extractors. Construction of roads—Draining, Irrigating, Models of Fences, Gates, Drains, Outfalls, Dams, Embankments, Irrigating Machinery, Stack Building and Thatching.

Class 683.—FARM BUILDINGS:

Models and Drawings—of Farmhouses and Tenements, Barns, Stables, Hop Houses, Fruit Driers, Ice Houses, Windmills, Granaries, Barracks, Apiaries, Cocoonaries, Aviaries, and Abattoirs.

Class 690.—SYSTEMS OF PLANTING AND CULTIVATION.

Class 691.—SYSTEMS OF DRAINING AND APPLICATION OF MANURES.

Class 692.—SYSTEMS OF BREEDING AND STOCK FEEDING.

United States and Canada.

Abstinence of English makers.

Absence regrettable.

With a few exceptions the Exhibition of Agricultural Machines was confined to the United States and Canada. The leading English makers were not represented. Only a few Exhibits were shown and most of these of an unimportant character. The reasons which determined our manufacturers not to exhibit were, first,—that the heavy tariff rendered American business impossible; secondly,—the great expense of transporting machinery; and thirdly, the impolicy of exposing their inventions for six months to the enterprising American machinists. These reasons are valid as far as they go, but we fear they were short-sighted. The Philadelphia Exposition has drawn together peoples of all nations and languages eager for information, many anxious to carry back to their distant homes such machinery as appears most suitable. The English Makers by their absence have left the field of enterprise open to the American Exhibitors, and, especially as regards the great South American countries, may henceforward look for competition where hitherto they have had almost a monopoly of the trade. Moreover, a comparison between the two great exporting countries of the world would have proved both interesting and instructive.

Exertions of Canadian Government.

Special Medals.

Great credit is due to the Canadian Government for having encouraged their somewhat unwilling Exhibitors to come forward by the offer of a large number of special Medals of different value, the adjudication of which was confided to the English Judges. The very creditable display of Dominion products in the Agricultural Department was due in great measure to this liberality. We cannot doubt that American trade, and in a lesser degree the Canadian also, will experience a beneficial stimulus in their foreign relations from the Centennial Exposition—a matter of great importance at a time when, as far as the home trade is concerned, production has overtaken and in many cases overrun demand. Nothing conveys a better idea of the vastness of the country and its agricultural resources than the fact that enormous manufactures of agricultural machines, amounting in some instances to tens of thousands annually, have hitherto found a home market.

Harvesting Machinery. McCormick of Chicago.

The most remarkable instance of this enterprise is seen in the case of harvesting machinery. The first practical Reaper was that shown by McCormick, of Chicago,

at the Great Exhibition of 1851. The firm, of which the original inventor is still at the head, turns out annually 12,000 independent machines. Three firms, the Champion Reaping Machine Co., Messrs. Whiteley, Fassler, and Kelly, and Warder, Mitchell, and Co., who all manufacture from one set of patterns, are said to make 30,000 machines per annum. The Buck-Eye Machines, made by Aultman and Co. and Adriance, Platt, and Co., are also sold in large numbers, whilst the Johnstone Harvester Co., F. L. Osborne, and Walter A. Wood are known as doing a large trade, both home and foreign. Another point in which the American trade differs from our own consists in the fact that whilst to a large extent, at any rate, our makers are purveyors for the farmer, supplying a variety of machinery, their manufacturers confine themselves, as a rule, to the production of a single article, on which they concentrate all their resources of capital and ingenuity, and consequently often attain a high degree of perfection. That the trade at the present time is overdone there can be no doubt; that this is due to the fostering influence of a high tariff is also probable.

Champion Reaping Machine Co.
Messrs. Whiteley, Fassler, and Kelly.
Messrs. Warder, Mitchell, & Co.
Aultman & Co.
Adriance, Platt, & Co.
Johnstone Harvester Co.
F. L. Osborne.
Walter A. Wood.

Class 670.—Tillage.

Spades, Hoes, Rakes, &c.

Manual Implements.—Spades, Hoes, Rakes, &c. &c., were shown by several firms. Ingenious in construction, of excellent material, admirably adapted for their particular uses, and much lower in price than with us; probably owing to both wood and iron being cheaper.

Ploughs.

Animal Power Machinery.—Ploughs were shown by numerous makers and of varying forms. Those for the Eastern States were of the ordinary type, *i.e.*, without wheels, or with one small wheel at the end of the beam, strong straight beam with short handles; the mould board of great strength, short and abrupt, adapted for rough work and especially for breaking up rough ground; capable of scouring, *i.e.*, keeping the face clean even in sticky soils, the object being to break up the furrow as much as possible, not to turn it over in an unbroken condition, which is the perfection of ploughing in England. These ploughs are well adapted for their work, but the draught is considerable.

Gang and Sulky Ploughs.

In the Western States Gang Ploughs and Sulky Ploughs are chiefly used. We have a frame on two large travelling wheels, with a driver's seat in the centre, the ploughs, which are double in the former and single in the latter, being suspended by beams from the axle. It is held, and correctly so, that the weight of the driver is counterbalanced by the use of large wheels, and the conversion to a great extent of a sliding for a rolling friction; draft might be further economised if the land side and sole of the plough were replaced by a friction wheel set at an angle and placed behind the body, as in our modern double-furrow ploughs; a leverage arrangement allows the driver to raise the ploughs clear of the ground at the land's end, and also to regulate the depth as the work is in progress. The draft is taken from the beam, the horses being yoked to a pole, and is therefore central.

Riding Ploughs.

After the war these Riding Ploughs came largely into use, owing to the number of maimed ploughmen, and during the heat of the struggle hands were at times so scarce that the wives and daughters of the farmers might be seen steering these machines. One of my colleagues, Mr. James Bruce, from Carvallos, Oregon, who formerly farmed about 1,100 acres, of which 500 acres were arable, assured me that he and his man were able to plough 50 acres a week during the winter season with two gang ploughs, each drawn by four mules; this gives over four acres a day for each implement. The occupations being extensive the distance to and from home is often considerable, and it is a great advantage to be able to trot always at the rate of six miles an hour. No opportunity occurred for a trial of ploughs, but there is no reason to doubt that both the Gang and Sulky Ploughs are capable of doing excellent work.

Canadian Ploughs.

The Canadians contributed a number of ploughs, some of excellent design, made very much after the English model, only stronger in the mould-board.

Acton Plough Co.
Single-Furrow Ploughs.

One of the most noticeable of the Single-Furrow Ploughs was that made by the Acton Plough Company, in which the beam was unusually prolonged, and bent behind the mould-board, securing direct draft. The handles or stilts are very short and represent nearly the half of a circle. The frame of the plough, of solid wrought-iron, forms part of the beam. In this department we noticed a double and treble furrow plough, made much like some of ours.

Sweden, E. Klundth, Ploughs.

E. Klundth, of Sweden, exhibited six ploughs, noticeable for construction, quality of material, fairly good finish, and reasonable price. Four of these were designed for the Russian trade, where the soil is generally light and does not clog. These have vertical friction wheels behind the land-side and projecting three-quarters of an inch below the sole, so that in dry soils the wheel does actually carry the weight. There is also a small wheel behind the mould-board. The Swedish ploughs have no wheels; the body is cast in one piece with the land-slide. The share is of wrought-iron laid with steel, and the beam and handles are in one piece. Another peculiarity which adds to strength is the prolongation of the land-slide until it occupies a space between the share and the mould-board. The Gottenberg Machine Company also exhibited a large collection of ploughs from their extensive works, which we understand find employment for 800 men. Most of these have a split beam with strong frame and separate handles; they are not so strong as the last described, but are on a good Scotch model. Owing to the low price of iron and labour these ploughs can be bought at home on most reasonable terms.

Gottenberg Machine Co.

Cultivators, Horse Hoes, &c.

Cultivators, Horse Hoes, &c. of various kinds were shown, some adapted only for single rows with or without expansive apparatus; others, and of these we would more immediately speak, have a double frame, with a driver's seat between large wheels. Such a machine is specially adapted for cultivating Indian Corn, which requires great attention during early growth. We select for description an excellent implement, shown by P. P. Mast and Co., of Springfield, Ohio, which has a moveable seat, and can be driven by attendant either walking or riding. Each frame carrying the cultivating tines is hung by a chain from the top of the upright standard. The arm or blade is jointed to the frame, and braced by an iron band, to which a wooden pin is so attached as to render the connection rigid under ordinary pressure. Should the tine or arm come into contact with a stump or fast stone, the pin breaks and the arm being jointed to the frame flies back, and thus serious breakage is avoided. This is a clever arrangement, of great utility in land only recently broken. To prevent the corn being cut by the knives, a rotating toothed wheel attached to an arm which is connected with the frame runs along the surface of the ground. Such a cultivator placed on 4-feet wheels runs light and is a very efficient implement; different forms of blades and points can be used, so that if desired the plants can be earthed up after all the weeds are removed. Some farmers object to these machines on the ground that some corn is injured on the headlands by the horses in turning; they prefer a smaller implement, taking half the interval between the rows at once, completing the space on the return journey; but the great argument in favour of the larger machines is the importance of rapid cultivation for a crop that grows with such amazing rapidity.

P. P. Mast & Co., Springfield, Ohio.

Non-adaptation of Steam Culture in America and Canada.

Neither American nor Canadian agriculture has as yet adopted Steam Culture. Considering the cheapness of fuel and the vast area of many of the farms together with the flat character of the prairies, this is remarkable. Owing to the superficial character of cultivating operations, the moderate price of horses and mules, and the general prevalence of light land, a necessity for steam culture has not yet arisen. It is a matter of regret that "Our Cousins" had not an opportunity of inspecting and seeing the work of our machinery. Traction engines, however, which are as yet but little employed, were shown by Messrs. Aveling and Porter, of Rochester; and those who witnessed the trials of Thrashing Machines and Portable Engines at Schenck's station, were surprised and delighted with their performances. Without their valuable assistance much time must have been lost. In the American section there was one exhibit of a Steam-Power Digger in which the engine was attached to the implement, the latter consisting of a series of revolving tines or forks. The locomotion of the machine being effected partly by steam and partly by the resistance of the soil to the diggers the exhibitor was not prepared to test his invention in the field, where, according to all experience, it would not have succeeded.

Traction Engines, Aveling and Porter, Rochester, England.

Steam-Power Digger.

Class 671.—Planting.

Corn Planters and Hand Drills.

Manual Implements.—Corn Planters and Hand Drills.—Of these there was a numerous collection both for small farm and garden use, many highly ingenious in construction.

Grain and Manure Drills; Corn and Cotton Planters.

Animal Power Machinery.—Grain and Manure Drills; Corn and Cotton Planters. In the case of Grain and Manure Drills the judges instituted a series of experiments to test the regularity of delivery under varying conditions of surface, which elicited important results, as will be seen by a comparison of the best and worst drills. It should be explained that the tests consisted of passing the machine over a given area, or rather causing the wheels to revolve a certain number of times representing the travel of the drill, first on the level, next on a hill side in two directions, lastly up and down very steep inclines, the angles being in excess of any natural conditions under which the drill could practically be worked. It should also be stated that whilst regularity of delivery on the hill side is most important, inasmuch as the work would be done in this direction, the results up and down the hill are not, because as a rule this plan of seeding a hilly field would be avoided, as heavy rain would wash the seed out of the drills. Each experiment represents the one-eighth part of an acre, sown at the rate of about two bushels per acre of wheat.

McSherry & Co., Dayton, Ohio.

—	Cup No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	Total.	Maximum.	Minimum.	Variation.	Variation per Acre from the level.
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
On level ground -	2 0¼	2 0¾	2 0½	2 1¼	2 0½	2 0¾	2 0¾	2 0	16 4½	2 1¼	2 0	0 1¼	—
Right-hand elevation - -	2 0	2 0½	2 0½	2 1	2 0	2 1	2 0¾	2 0	16 3¼	2 1	2 0	0 1	− 0 10
Left-hand do. -	2 0	2 0	2 0½	2 0¾	2 0½	2 1	2 0¾	2 0	16 3	2 1	2 0	0 1	− 0 12
Down hill - -	1 12½	1 11½	1 13	1 13¾	1 12¾	1 13½	1 13	1 12¾	14 8¾	1 13¾	1 11½	0 2¼	− 14 14
Up hill - -	2 3½	2 6	2 3½	2 3¾	2 2½	2 3½	2 3½	2 2¼	17 11¾	2 6	2 2¼	0 3¾	+ 11 10

P. P. Mast & Co., Buck-eye Drill, Springfield, Ohio.

—	Cup No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	Total.	Maximum.	Minimum.	Variation.	Variation per Acre from the level.
	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
On level ground -	2 0¾	2 0½	2 0½	2 0½	1 15½	2 0½	2 0½	2 1	16 3	2 1	1 15½	0 1½	—
Right-hand elevation - -	1 13½	1 13	1 12½	1 13½	1 12½	1 13	1 13	1 13½	14 8½	1 13½	1 12½	0 1	− 13 4
Left-hand do. -	2 3	2 2½	2 3	2 2¾	2 2	2 2½	2 2	2 2½	17 4½	2 3	2 2	0 1	+ 8 1
Down hill - -	1 12½	1 11½	1 10¾	1 11¾	1 10½	1 11¾	1 12	1 11¾	13 12½	1 12½	1 10½	0 1¾	− 19 6
Up hill - -	2 6½	2 5¾	2 7¾	2 6½	2 4½	2 4¾	2 5	2 5¼	18 14	2 7¾	2 4½	0 3½	+ 21 8

Drills, McSherry & Co.

The reader will notice the variation per acre from the level in the two drills. In McSherry & Co.'s Drill, the quantity of seed is almost identical, whether the drill is on the level, or inclined from either side at an angle of about 30°. In the up and down direction the variation is considerable, but, as before explained, this is not of much consequence. In the drill made by Mast & Co. the variation is very serious. Thus, on the hill side, whether the elevation is on the right hand or left, the difference is great, and the range between the two actually reaches nearly 22 lbs. No wonder we so frequently notice the thin and weak appearance of every alternate drill track, especially with the old-fashioned English drill in which the delivery of the seed depends upon the revolution of spoons attached to discs on the spindle. When the seed-box is placed at a considerable angle much of the seed is thrown over the sides of the seed-cup, and passes back into the hopper. The great desideratum in a drill is even distribution of seed.

Force Feed.

One of the most noticeable improvements which distinguish American inventions is the presence of a Force Feed. There are various ways in which

this is secured. The most common plan is to have a roller on the shaft, either fixed or sliding, which working in a confined position (the seed-cup) carries a certain quantity of grain round with it for each revolution, discharging into tubes, &c. which convey it to the ground. These rollers are various as to form and surface corrugations, but the great point of difference as to results depends upon whether the roller fills the seed-cups, or only occupies a varying position according to the quantity of seed to be sown. In the latter case it will be readily understood that when the inclination of the land causes the seed to fall away from the roller a smaller quantity of seed will be sown than either on the level or when the seed accumulates over the roller. All the experiments were favourable to those drills in which a feed-roller fixed on the spindle occupied the entire space of the seed-cup. The quantity of seed to be sown is regulated in two ways, either on the old plan of change wheels causing the seed spindle to revolve faster or slower, or by closing or opening the mouth of the seed-cups. The latter plan has an apparent advantage, viz., that the regulation can be more minute and made whilst the drill is in motion. Nevertheless, all the tests that were applied proved that the plan of change wheels is the more accurate.

Separate box for sowing small seeds.

Nearly all the drills were provided with a separate box, either placed in front or behind the drill, for the sowing of small seeds such as Timothy Grass and Clover. The Coulters, or Hoes, as they are called in America, are fixed as to width, generally sowing at 8 inches, but the alternate coulters can be set forward 7 or 8 inches, and thus present a broken line with more space for the passage of surface obstructions—a necessary adjustment when the surface has been recently broken up. A clever combination of levers raises the coulters out of the ground and throws the drill out of gear by one action, and this so instantly that no grain is wasted. The lower portion of the coulter frame is hinged, so that in the event of coming in contact with a fast stone or tree root, a not unusual occurrence in many districts, the coulter flies back, and accidents are avoided. As soon as the machine is clear of the obstruction, the coulter, acted on by a powerful india-rubber spring, returns to its place. This is a very ingenious and perfect arrangement.

"The Surveyor."

Many of the better machines have a small apparatus attached for indicating the area travelled during work; this is known as "the surveyor," and comprises a thread on the seed spindle actuating a small toothed wheel which drives an indicator on a dial plate. Of course absolute accuracy is not attained, the comparative roughness or smoothness of the surface affecting the result, but a close approximation is obtained—a guide to the workman as to the distribution of his seed, and a tell-tale for the master as to his servant's industry. As has been noticed above, the coulters are fixed and the grain must be deposited at uniform distances. Alternate cups may be closed, doubling or trebling the intervals, but as there is no means of otherwise regulating the spaces as in English machines, it would be desirable if this objection could be overcome. In all other respects I am of opinion that great progress has been made, and that American drills are superior to ours.

Manure boxes.

Manure boxes are attached to some of the drills so as to allow of a varying quantity of artificial manure being applied with the grain. These were subjected to experiment, first with dry, and then with damp, Superphosphate, but so poor was the manure that it would not work up into a pasty condition so necessary to prove efficiency. It is very difficult to make a machine that will deliver with regularity; such manures as Peruvian Guano, or good Superphosphate, work into a pasty condition, and are delivered in lumps; and, apart from this objection, it is doubtful if the application is economical. Ammoniacal manures have, especially in a dry climate, a marked tendency to check germination. Again there is risk, particularly in light soils, that the soluble portions of the manure may be washed away before the crop is ready to make use of it. Of the machines that were tried Bickford and Huffmans was the only one considered worthy of award. This has a series of star-shaped revolving scrapers working close to the bottom of the box, with cutting edges and surfaces slightly concave under and convex above, which bring the manure over the parts which are regulated by a sliding bottom.

Corn Planters, *i.e.*, for Maize;

Corn Planters, *i.e.*, machines for planting Indian Corn, were both numerous and of ingenious construction. The original inventor was Mr. Geo. Brown, of

Galesburg, Illinois, whose planter still holds its place as a well-made and efficient machine. The importance of the corn crop, especially in the Western States, is so great that it is natural that much attention should be devoted to these implements. The object of the farmer is to plant the corn in lines about four feet apart each way, putting three or four grains into each spot, not huddled together but somewhat scattered. Accuracy of work so that the lines intersect at right angles is very important, as allowing of more perfect cultivation during growth, on which and the previous preparation of the land the result greatly depends. When the surface is made ready for the seed, that is reduced to a fine condition, the ground is marked out by running the planter across the field empty; a marker consisting of a lever arm with a shifting pointer indicates the line for the wheel track on the return journey. Great care is exercised to commence planting at exactly right angles to the cross lines. The machines which are commonly used consist of a jointed frame supported on broad wheels; across the frame and immediately in front of the wheels are the two seed boxes. The driver's seat is in the centre, between and somewhat behind the wheels, his weight acting as a balance. Immediately in front of him and between the seed boxes is the seat for the boy, who sits crossways so as to work the lever handle in connection with the dropper which regulates the discharge of seed at the proper intervals. In front of the runner is a coulter, which opens the ground for the reception of the seed, and in the case of the Keystone Corn Planter manufactured at Sterling, Illinois, this shoe is adjustable. The corn is dropped from the rear of the runner in view of the driver, who can thus see that the action is complete.

Mr. Geo. Brown, Galesburg, Ill.

Keystone Corn Planter, Sterling, Illinois.

In the best machines the corn is first deposited in a lower chamber; the distance from this to the ground is small, and the action of the valve causes the corn to be ejected with a side and backward motion which ensures it being scattered in the hill. More or less seed can be sown as required. The frame carrying the seed boxes, &c. can be raised clear of the ground by foot leverage, for turning at the land's end and for travelling. In some machines the surface of the wheels are concave, which causes a slight elevation to be made by their track. In this way the grain can be planted with great accuracy, and the crop has a very symmetrical appearance and can be dealt with to great advantage in the subsequent tillage operations. An attempt has been made to make the action automatic, and so save the work of the boy as well as the marking out.

The Haworth Planter Co., of London, Ohio, have patented an invention whereby the desired result is obtained by means of a rope made fast at both ends of the field; this rope, which has knots at the requisite intervals, passes over and round pulleys on the planter; the action of the knots causes the grain-dropping apparatus to come into operation. We believe this invention, which we did not see at work, is thought highly of. The price, 30 dollars, which includes a quarter of a mile of rope, does not appear extravagant. Another invention, by Joseph Rothschild, of Shellyville, Kentucky, shown at Philadelphia was only patented on April 18th, 1876, and admits of much improvement in detail, but is sufficiently ingenious to merit a short notice. The dimensions of the travelling wheels set out beyond the seed boxes are such that each half revolution causes the cam to actuate the dropper at suitable intervals. Two spring discs on each wheel mark the spot where the corn is deposited and act as track markers. The wheels have a series of spikes on their surfaces. If the wheel discs on the return journey are not in a line with the holes made before, and consequently the seeding is out of line, then the attendant by lowering or raising the wheel, for which suitable machinery is provided, causes ground to be gained or lost as required; of course a marker is used to indicate the line to be traversed. This is a highly ingenious arrangement, and likely to become, when perfected, of great use.

Haworth Planter Co., London, Ohio.

Joseph Rothschild, Shellyville, Kentucky.

Several Single-Horse Planters taking one row at a time were shown, the dropping apparatus identical with those already described, variable as to the quantity of seed and the distance between the drills. Such machines are suitable for small occupations, being more expeditious and cheaper than the ordinary system of planting by hand, which hitherto has been principally followed in the Eastern States. It should be stated that the dropping apparatus is so excellent in the best corn-planters that the variation in delivery seldom exceeds one grain; three or four are generally deposited.

Single-Horse Planters.

Class 672.—Harvesting.

Manual Implements.
James Fussell, Sons, & Co., England, Royal Würtemburg Furnaces.
Austrian Government.
C. E. Pettersen, Sweden.

Manual Implements. — Grain Cradles, Sickles, Reaping Hooks, and Scythe blades, Hooks, &c. were shown by several American firms, as also by James Fussell, Sons, and Co., England, Royal Würtemburg Furnaces, by the Austrian Government from several firms, and by C. E. Pettersen, Sweden, &c., the quality of material and the manufactnre being in all cases creditable.

Animal Power Machinery.—Reapers and Headers.

Animal Power Machinery.—Reapers and Headers.—Here are found by far the most interesting and important features of the Exhibition. The display of Reaping Machinery was both large and varied, so much so that from its study one can form some idea both of the vastness of the country and the varied character of its requirements. What, for example, can be more different than the clumsy-looking heading machine, which, severing the straw in the middle, conveys the produce to the attendant waggon, to be at once carried to the barn, and the neat light sheaf or table-rake machine which, drawn by two horses, severs the crop close to the ground, and deposits the gavel or sheaf in neat bundles clear of the machine. Apart from these are the modern Harvester which by means of a transverse revolving carrier and elevator raises the cut grain on to a tying platform, where two or more hands make the bundles; the facilities thus afforded reducing the manual labour by at least one third to one half. Lastly, we have the Automatic Binder, the realization of a long-wanted and much-desired combination, which formed the special feature of the Philadelphia Exhibition. These binders are made on the plan of the harvester, manual labour being replaced by mechanism which binds the sheaf with wire, twists the same, and cuts it off, and either throws off the sheaves, as they are made, by a spring, or allows them to be ejected by the pressure of the following sheaf. Four such machines, exhibited by M'Cormick, Walter A. Wood, F. L. Osborne, and D. M'Pherson, were tried near the Schencks Station on a moderate up-standing crop of wheat, and all but the last named performed respectably, the Osborne machine making excellent work. The failure of M'Pherson's invention was due rather to bad construction than to defective mechanism. It would be premature and indiscreet to say that the present will be the ultimate form, or that the mechanical arrangements are perfect; probably they admit of simplification, but just as the Exhibition of 1851 was memorable for the introduction of a Reaping Machine will this be remembered as the first public occasion on which Automatic Binders were successfully worked.

Automatic Binder.

Trials.

Table Rakes.

A word or two as to Table Rakes may not be out of place, seeing that this form of reaper is unknown in England. The ordinary sweep-rake is replaced by a jointed rake which travels in a given orbit on the table or platform, being driven by universal joint and bevil gearings, the direction of travel being regulated by a cam screened from the grain by a shield. The advantages claimed for this invention are reduction of draft, and superior form of the grain for binding. The rake when uncontrolled works continuously, but can be arrested at any point by a leverage from the driver's foot; this is a desirable feature, allowing of uniform sheaves in a variable crop. The disadvantages appear to be, that as the rake compresses the grain at the corner of the table there is some risk of shedding when over-ripe; also, that the compact nature of the sheaf interferes with the drying influence of sun and wind, so important when corn is cut in a green condition, and, lastly, the table-rake is not suitable for very heavy crops, especially if the straw is long. The large proportion of reaping machines were of American manufacture, but the Canadian exhibits, principally formed on American models, were both numerous and highly creditable; more especially was this the case with the exhibits shown by L. D. Sawyer and Co., of Hamilton, Ontario. In the Russian department were two machines of peculiar construction, which appeared much behind the best American or English models.

L. D. Sawyer & Co., Hamilton, Ontario.

Mowing Machines.
Eureka Mower Co., Towanda, Pa. Eureka Direct Draft Mower.

The display of Mowing Machines was nearly as large as that of Reapers; most of these were constructed upon well-known models, but one or two novelties deserve consideration. The Eureka Direct Draft Mower, made by the Towanda Eureka Mower Co., of Towanda, Pa., though not shown for the first time, has been greatly improved, and both by its work and the lightness of draft attracted much attention. The draft is direct, *i.e.*, is taken from the centre of the frame between the travelling wheels, which are much higher than in

ordinary mowers. The knife works in front of and between the said wheels. The horses are kept so wide apart by means of a long neck yoke that whilst one walks close to the standing grass on land from which the cut grass has been cleared by the track board, the other travels on the uncut grass to the right, and clear of the cut of the knife. It might be thought that the grass would be difficult to cut in consequence, but this is not the case, as the knife meets the trodden-down grass on the return journey, and no difference is perceptible. One of the strong points in favour of direct draft is that the machine can return in a parallel line, and has not to cut round a plot as in ordinary side-draft machines. Thus a difficult crop can be cut in any direction that is desirable. Supposing a heavy crop has become laid in one direction the ordinary form of machine could only make good work when meeting the crop, and must run empty through much of its traverse. The direct draft mower can be worked backwards and forwards across the direction in which the grass is laid, and thus make excellent work. Another very important feature is that, having a track-board or clearer on each side, the cut grass is laid up in a beautifully light open swathe, very favourable for haying; indeed in fine hot weather little or no after-work is required.

In the machine that was tried the knife was 6 feet long, yet a pair of horses worked the machine with ease, and out of twenty machines tested with the dynamometer it was the lightest, consuming only ·288 of a lb. draft for each square foot of grass cut, the figures ranging up to ·564 in the case of one of Osborne's machines for the same work. A flexible jointed cutter-bar allows of fair cutting even when following a laid crop, but this is a mode of working that is never necessary. Machines are made with 8-feet knives which are said to be equally successful, but for heavy crops and rough uneven ground the 6-feet width is quite ample. The second novelty to be noticed is the "Haymaker" mower, made by Otis and Co., of New York, which is commendable for extreme simplicity and obtaining the object with the least complication of parts, and therefore with the minimum friction. The motion is transmitted from the travelling wheels to the knife through a single pair of bevil wheels Thus we have a small bevil wheel with 46 teeth fixed to the axle, and therefore revolving with the wheels, gearing into a similar wheel in all respects, only furnished with two more teeth; but this wheel being hung on a gimbal joint like a ship's compass does not revolve, but when set in motion makes a series of rapid serpentine vibrations around the face of the other wheel; an arm extending from the vibrating disc down to the knife gives to it the required reciprocating action. The motion is remarkably pretty and direct, and as six or eight teeth are always engaged at once instead of two or three, as in ordinary gearings, the wear is more evenly distributed. There is only one rotating axle besides the main axle, viz., that of a small fly-wheel, which tends to give regularity and steadiness of motion. The only point likely to wear is the gimbal joint, which is easily renewed, and contrasts favourably with the boxes and bearings of ordinary machines. It is noiseless in running, and the work done on up-standing grass was excellent, but owing to not having a flexible cutter-bar, which can be easily applied, the laid grass was not cut well. The knife is well speeded, viz., 23 revolutions, or 46 cuts for each revolution, of the wheel. Out of 20 machines tested by the dynamometer the "Haymaker" stood fourth for lightness of draft. I think this machine has points of great merit, especially its extreme simplicity of parts and perfectly smooth action.

Details.

"Haymaker," Otis & Co., New York.

Mr. W. Farr Goodwin, of Stelton, New Jersey, is the author of two novelties. The older machine shown by the Screw Mower Company has the ordinary gearings replaced by a large gun-metal screw-wheel on the axle, driving a worm on the crank shaft. The screw-wheel works in oil, the cover being a receptacle. It is quite evident that without a constant supply of oil the wheel would wear; this condemns the principle. Moreover, though the cutting was well done the draft was heavy. Mr. Farr Goodwin's second invention, which he showed himself, is certainly ingenious. In the Reciprocating Screw Mowing Machine there is neither gear or cog-wheel, crank-wheel, or revolving journal, save the main axle on which is arranged the peculiar mechanical contrivance for converting rotary into reciprocating motion, by reciprocating screw on the nut and bolt principle. The power is thus applied very directly, but the friction on the surfaces of the

W. Farr Goodwin, Stelton, New Jersey.

Reciprocating Screw Mowing Machine.

C. Russell & Co., Canton, Ohio. Champion Co., Springfield, Illinois. Warder, Mitchell, & Co., Whiteley, Fassler, & Kelly, Springfield, Ohio. Rochester Agricultural Works, Rochester, New York.

screw-wheels must be considerable, as the draft was by no means light. Of the ordinary constructed machines the "Peerless," made by C. Russell and Co., Canton, Ohio, the Champion machines, made by the Champion Co., Springfield, Illinois, Warder, Mitchell, and Co., and Whiteley, Fassler, and Kelly, both of Springfield, Ohio, and a simple and practical machine shown by the Rochester Agricultural Works, Rochester, New York, were all light in draft, and did excellent work. It will be evident from what has been advanced that the manufacture of Reaping and Mowing Machinery, and of combined Reapers and Mowers, has reached a high state of perfection in the States, and it is satisfactory to find that Canada is not far behind; with the exception, however, of Mr. Sawyer's inventions, already alluded to, and which the judges considered of high merit, most of the Canadian machines were on American models.

Foust's Hay Loader, Stratton and Cullum, Meadville, Penn.

The Americans have paid much attention to machinery for expediting the processes connected with the harvesting of hay, especially with a view to the economy of labour. It should be stated that, as a rule, the hay is stored away in barns, and is seldom stacked as in England. One of the most practical and successful inventions in this direction is Foust's Hay Loader, shown by Messrs. Stratton and Cullum, of Meadville, Pennsylvania; this implement, which is hooked on behind the wagon, and can be detached or attached with the greatest ease, resembles in form an English Hay Tedding Machine, the tines or forks being more bent, and having a back-action only. The horses attached to the wagon should be harnessed sufficiently wide apart to allow of their walking clear of the wind-row. The tines take up the hay more perfectly than is possible by manual labour, and a light elevator with a wind-guard conveys it to such a height as allows it to fall into the centre of the wagon, where two men are kept hard at work stowing it away. The simplicity of the apparatus and consequent non-liability to get out of order are features of great importance. Looking at the work of the men on the wagon we are led to the conclusion that this loader does the work of four pitchers. The action is continuous and perfect; all that is necessary for success is that the wind-row should be uniform as to width and bulk. A horse-rake collects the hay previously scattered, into rows of the proper consistency, and a very small expenditure of manual labour levels the hay into a uniform condition. Not less clever or efficient are the unloading forks and conveyers by which the wagon is emptied and the produce conveyed to any part of the barn as required; by such assistance the whole business is greatly expedited. Thus, two men on the wagon to load, one on the wagon to manage the unloading fork, two in the barn to stack the hay, are all the force actually required with two boys to drive the wagons. It should be mentioned that a horse is used as the motive power in connexion with the harpoons, the communication being by ropes travelling over pullies. Hayforks of various designs were shown. Thus we have the single and double harpoon and the expanding forks. We had no opportunity of testing the latter, but, as far as we could judge of the former, the double harpoon is the more effective.

Class 673.—Preparatory to Marketing.

Thrashers.

Fison's Patent Safety Drum Guard.

Thrashers.—America and Canada were well represented. Russia showed one machine constructed on the English model, and the only English exhibit having any connexion with the subject was Fison's Patent Safety Drum Guard, a very valuable invention, which obtained the first prize at the R. A. Society's trials. Although an earlier invention than reaping and mowing machines, the thrashing machinery of America does not show equal progress, and I think that here at any rate the English machinsts are decidedly in advance. The modern thrashing machine combines several operations formerly performed by separate implements, but the great feature round which all the other motions revolve, so to speak, is the proper separation of the grain from the straw. This should be the first consideration. More than twenty years ago we abandoned the Scotch peg drums, and introduced in its place drums or cylinders with longitudinal convex beaters, which aided by the adjustable convex strip the grain from the straw at one operation so perfectly that no second operation is required, whereas in the American and Canadian machines, when the peg drum is retained, a provision is made for bringing back and re-thrashing such ears as have escaped or only been partially thrashed, because the pegs on the

surface of the drum and the smaller projections of the concave, strike instead of stripping.

I found two distinct types of machinery as shown by Americans. In the original form the produce after passing the drum or cylinder is carried forward, grain and straw, by an inclined revolving cloth furnished with cross-sections or cups of wood a distance of quite 10 feet, then the grain chaff falls into the riddle, and is separated from the straw. The grain and chaff passing through the openings of the riddle meets the blast of the winnower. The chaff is blown right out of the machine, whilst the grain passes to the sack by means of a spout. The unthrashed heads, &c., which may be distinguished as cavings, pass over the end of the riddle, are conducted by a spout to the elevator, carried back to the drum, and re-thrashed. The straw passes from the carrier on to the straw belt, being aided thereto by a revolving triangular piece of wood known as the "picker." The straw belt is agitated so as to carry on the straw by a series of jerks a distance of 5 or 6 feet, so that any loose grains carried over with the straw may be separated, passing through the open spaces of the belt and down an inclined plane to the screen.

Types and method of working.

Early type.

In the second class of machines, which are of more modern type, the cloth carrier is replaced by shaker frames and reciprocating forks. The drum and concave are open, so that a large proportion of the grain, &c. is separated from the straw at once, whilst any that passes forward with the straw is shaken out during its forward passage and passes back to the winnower. This is evidently an improvement, reducing the work that has to be done; it must be bad economy to carry the grain, &c. a distance of 10 feet, when it might be at once got rid of. It is said that the American machines are capable of thrashing more rapidly than our more complicated and complete inventions; it may be so, but those that were tried at Schencks Station did not particularly distinguish themselves in this way. It is quite certain that they do not, as a rule, thrash clean at one operation; hence the arrangements for re-thrashing the ears which find their way back by the elevator. The grain is not very perfectly winnowed, as there is only one fan, and this is usually driven from the drum shaft; consequently the blast is somewhat irregular. An attempt has been made to remedy this by providing in one machine, that of the Geiser Company, self-adjusting shutters, but whether the action is sufficiently quick to be effective was not proved. The straw is much broken, no disadvantage for litter purposes, but requiring more labour to handle. On the whole I think the improved English machinery very superior, inasmuch as the separation is complete by the first intention. The grain is more thoroughly winnowed, and subjected to the brushing or scrubbing motion which polishes the surface, and adds something to market value; possibly less can be done in a given time, but the bulk of the corn is ready for market, and after expense is saved. The elevators to convey the straw from the machine to the stack or waggon are hung on to the machine, and are simple and inexpensive, answering well in calm weather, but useless in a cross wind, as the sides are low, and there is no sort of cover or guard. Several of the machines were of small power, adapted for small farms when steam power was not available; these were worked by two-horse railway powers, which may be best described as a sort of equine treadmill, the animals constantly walking up hill. There is no doubt that considerably more duty is obtained in this way than through horizontal horse gears. The requisite conditions are that the driving wheel and bearings should be large, the pace of travel not exceeding 1½ miles per hour, and the elevation of the horse track not more than 14° to 15°. Under such conditions these powers are valuable for various kinds of work, and are not necessarily horse killers, as they have been sometimes described. The larger Thrashing Machines are generally worked by 8 or 10 horses in horizontal gears, the power being communicated by tumbling shaft and cog-wheels. Mr. John A. Hafner has invented a patent coil spring to be attached to the driving gear wheel, which accumulates the power and prevents the sudden shock which would otherwise be felt when the horses start suddenly. The invention consists of a cylindrical coil of three plates made of the best cast spring steel, contained in a box which is fitted on to the driving gear wheel. It can be applied to all machines, whether worked by horses or steam, driven by gear or belt, but its peculiar value is for horse gear machines driven by gearing. It was tried on a machine of the Pennsylvania Agricultural Works Company, and answered admirably.

More modern type.

Geiser Company.

Mr. John A. Hafner.

Pennsylvania Agricultural Works Company.

Cotton Machinery.—Coffee Hullers, Rice Mills, &c.

Cotton Machinery.—Coffee Hullers, Rice Mills, &c.—Seven Cotton Gins were exhibited in the American section, all made by northern mauufacturers. The best of these machines are of excellent construction, and do their work very effectually. The main feature comprises a series of circular saws, revolving with great rapidity. The serrated teeth tear the cotton to pieces, and separate it from the seed; the cotton is next brushed and passed on to the condenser, by which it is reduced to a proper condition for packing. The value of self-feeders as a protection to the attendant is unquestionable. Two forms were exhibited, viz., the original invention by S. Z. Hall, of New London, Connecticut, which comprises a large hopper with revolving rollers at the bottom with spaces between, which allows of the escape of dust, &c. The cotton thrown into the hopper is conveyed by the rollers to a wooden roller with numerous small spiked teeth, and being carried round between it and a fine meshed wire frame allows of a further separation of dirt, &c. The cotton falls from the roller on to the cutters. In Brown's Feeder, which is also made at New London, the bottom of the hopper has a series of fixed and moveable bars with iron serrated teeth, which carry forward the cotton with great regularity. On the whole the Needle Gin shown by E. Remington and Co., of Ilion, New York, appears the most valuable. The peculiar feature is the substitution of needles for serrated surfaces. The needles are made in sections of best steel wire, with rounded surfaces, and covered with Babitt Metal. The advantage is that the needles neither tear nor saw off the cotton, and the fibre is better preserved. The ribs between the needles are peculiar, having a flange in the centre on the upper surface, which tends to keep the cotton over the needles. The Babitt Metal does not heat, which renders it safer than the ordinary saws.

Mr. S. Z. Hall, New London, Conn.

Brown's Feeder.

Needle Gin, E. Remington & Co., Ilion, New York.

David Kahn-Yeiler, New work.

Cotton Seed Hullers of different sizes were exhibited by David Kahnweiler of New York. One of these, designed for plantation use, is valuable as a means of preparing the seed for cattle food. It does not always answer to sell the seed for its oil, especially if the farm is far from the market; in such cases it is most important to be able to remove the cotton and shell. The machine comprises a hopper with a revolving feed-roller cast in small sections, which prevents nails, &c. entering into the mill with the seed. The mill consists of an under roller with smooth surfaces, carrying eight knife sections placed in different positions, so as to act like a screw. This roller works against a breast with four knives. The shell and seed are separated by a fine screen. Cotton Presses were shown both for power and hand.

Corn Huskers, &c. Phillip's Spiral Corn Husker, R. H. Allen & Co., New York.

Corn Huskers, Shellers, &c.—There was only one machine shown to economise the labour of Corn Husking—Phillip's Spiral Corn Husker, shown by R. H. Allen and Co. of New York. This appears a valuable invention, which should command an extensive sale. It consists of a frame, across one end and near the top of which are placed two picking rolls with spiral grooves, between which the stalks are fed, and in passing them the stalks are separated from the ears, which drop on to the husking rolls, placed lower down at right angles to the picking rolls, and in an inclined position. These rollers have grooves corresponding with spikes in the opposite roller. The latter are arranged spirally upon the rollers, and hold the husks at one end of the ear, and continue the grasp to tne opposite end, making the process very similar to husking by hand. A machine costing 150 dollars is capable of husking 25 to 30 bushels an hour.

Corn Shellers, Sandwich Manufacturing Co., Illinois.

Corn Shellers were shown in considerable abundance, both for hand and power. The former may be useful where corn is grown on a small scale, but as most were without feeding apparatus or winnower they do not admit of strong advocacy. The Sandwich Manufacturing Company, of Sandwich, Illinois, took a decided lead in power machines, and, as Indian Corn occupies the most important crop position in the States, a short description of these inventions will not be considered out of place. Machines of three sizes, viz., for four horses, two horses, and one horse are made. In the large machine there is an excellent feed elevator, consisting of four endless rubber straps with convex projections, travelling between three fixed wooden bars. The result of this arrangement is, that however carelessly the cobs are placed on the elevator they become straightened in their passage, and are fed into the mill with regularity, being aided thereto by a force-feed spindle furnished with iron flanges; next the corn is caught by four vertical disc wheels, 7 inches in diameter, covered with small teeth; these known as "Little Pickers" revolve about 600 times a minute, and propel the

corn to two large picker wheels, also vertical, and having teeth on both faces, which aided by strong steel springs hold the corn whilst the bevel runners, 12 inches diameter, with coarse ribs radiating from the centre and running 700 revolutions per minute, strip the corn from the cob. The latter is thrown out on to a wire elevator made in two parts; the furthest, at a lower elevation, allows of any loose grains that may have been carried along with the cobs passing back. The corn falls on a riddle, is winnowed and elevated into sacks or wagons as required. The four-horse machine shells 150 bushels an hour.

Class 674.—Applicable to Farm Economy.

Portable and Stationary Engines.—A trial of Portable Engines was carried out at Schencks Station, and comparative results obtained, which enabled the judges to make their reports. With one exception, that of a Russian firm, all the machines tested were of American construction. Speaking generally, the object appears to be to make an engine easy of transportation and reasonable as to price, without much regard as to the question of duty. In other words, the boiler and fire-box capacity are insufficient to produce economical results. Doubtless practical experience has guided the makers. Bearing in mind that much of the work of Portable Engines is done in winter, it would be advantageous if the cylinder and boiler were felted and lagged, which is at present quite exceptional. As far as could be judged, and making due allowance for the difference of fuel, I am of opinion that the best forms of portable engines in this country are greatly superior in efficiency. Messrs. Davey, Paxman, and Co., of Colchester, exhibited both a Portable and Vertical Engine, well-known machines, and Mr. Fison, of Cambridge, was also the exhibitor of a small Vertical Engine. The Russian exhibit from the factory of Lilpop, Rau, and Loewenstein, of Warsaw, may be described as a Vertical Portable Engine of very strong construction, but inconvenient arrangement, with great boiler capacity, secured by 50 vertical tubes. At trial steam was raised in one third less time than in any other engine.

Portable and Stationary Engines.

Messrs. Davey, Paxman, & Co., Colchester, Portable and Vertical Engine.

Mr. Fison, Cambridge, Vertical Engine.

Lilpop, Rau, and Loewenstein, Warsaw, Vertical Portable Engine.

Chaffers, Hay and Feed Cutters, Slicers, Pulpers, &c. — These exhibits though numerous were not remarkable; hitherto, especially in the Western States, little has been done in the way of food preparation. Straw is almost valueless. Of the American Chaff Cutters, those by Messrs. Silver and Denning, of Salem, Ohio, appeared the best, having a good arrangement for the protection of the knives in case stones or iron get into the feed. The fly-wheel continues to revolve, but the knives, which are on a separate shaft, stop; this is effected by a friction cone on the said shaft. The arrangement for altering the size of cut by shifting a cluster of gear wheels is also simple and efficient. Canada, following the English patents, takes a decided lead in Chaff-Cutting Machinery; some excellent Machines both for Chaff-cutting, Pulping, and Slicing are shown by John Watson, of Ayr, Ontario, whose whole collection, both for its size and useful variety, is most creditable. David Maxwell, of Paris, Ontario, was also a successful exhibitor, nor must I omit to mention a very efficient Hand-cutter, without wheel or gearing, of Mr. A. Anderson, London, Ontario, which commanded an extensive sale.

Chaffers, Hay and Feed Cutters, &c.

Chaff Cutters, Messrs. Silver and Denning, Salem, Ohio.

John Watson, Ayr, Ontario.

David Maxwell, Paris, Ontario.

A. Anderson, London, Ontario.

Corn Mills.—Both stone and metal were shown by several makers. The latter, of both vertical and conical form, were meritorious, on account of material used and efficient operation. The Farmers' Feed Mill, of Sedgemeer and Miller, of Ohio, consists of vertical discs, covered with Y-shaped projections in alternate circles, ground down with emery to a fine surface. This useful mill works equally well in either direction, and having flat surfaces is not injured by contact. W. S. Boyer and Brothers, of Philadelphia, exhibited mills of a conical form; the surface, both of the mill and concave, have fluted surfaces; the edges sharpen themselves by contact. In one of these machines a bolting screen is attached, and by a clever arrangement the same jigger from the wheel acts on the hopper above and the screen under. Mr. Watson also shows a mill with vertical plates, with striations on the grinding surface, which appears a very useful machine.

Corn Mills.

Sedgemeer and Miller, Ohio.

W. S. Boyer & Bros., Philadelphia.

Mr. Watson.

Messrs. Jaacks and Behrens, of Lubeck, showed a Model of Millstones with their Patent Aspirator, this appears to be a valuable invention for securing a current of air between the stones, and for removing moisture. The air enters above, passes through the centre, and is exhausted. The flour is forced out by

Messrs. Jaacks and Behrens, Lubeck.

an endless screw with a valve mouth, so that no air can enter save by the aspirator. The flour is prevented from passing the exhaust by a number of triangular shaped surfaces of flannel, which hang down all round, and present surfaces for the flour to fall against; these are automatically vibrated. In the French Department, Du Vivier & Co. show a novelty in the Aubin Bolting Millstones, in which the lower stone has spaces from the circumference to the centre occupied with metal bolting sieves, which are agitated by knockers, the flour passing through. The bran escapes between the stones.

Du Vivier & Co., Aubin Bolting Millstones.

Class 675.—Dairy Fittings and Appliances.

Cheese-making.

To the United States belongs the credit of introducing the factory system as regards Cheese-making. Sweden took the lead in butter. England has recently been following in the same track, and the Derby Cheese Factories have met with encouraging success. At the back of the Agricultural Hall was a neat wooden structure with overhanging eaves and every appliance made use of in a modern cheese factory. I was, however, somewhat disappointed at the absence of statistical information as to the progression of this industry. Owing to the heat of the weather no cheese was made during my stay, but later on it was proposed to manufacture on a large scale. The only complete apparatus for making cheese was shown by H. H. Roe & Co., of Madison Lake Co., Ohio, and Carl Otterling, of Orebro, Sweden, the latter on the Cheddar principle. Much excellent apparatus was shown for working butter. Churns were very numerous. The old forms are most in favour. I was much pleased with the Oscillating Churn, which is devoid of dashers, the action depending upon the agitation of the churn, which oscillates backwards and forwards. Butter Workers were also numerous, some very excellent. Thus the Power Machine shown by P. Shaw, of Scituate, Massachusetts, is commendable, both for simplicity of mechanism and efficiency of action; it comprises a vertical screw press, to which is communicated an up and down motion by a crank underneath, and a revolving circular table adjustable as to position in reference to the press. This table revolves upon and forms the top of the butter-milk receptacle, which is also an ice-box when required. The operator revolves the table as required so as to bring every portion of the butter under the action of the worker. The Hand Machine made by P. Embree and Sons, of West Chester, P.A., is equally meritorious. It comprises a revolving cedar-wood table with a convex surface, on which the butter is placed and pressed by a revolving conical fluted roller, with cleaner attachment, actuated by a lever handle; at the opposite end of the roller shaft is a small pinion working into toothed gear in the centre of the table, causing the latter to revolve. The butter is thus thoroughly worked, all liquid expressed finding an exit through holes in the table. The roller is easily detached, and both it and the table are readily cleaned. This machine is applicable to all but the largest factories.

H. H. Roe & Co., Madison Lake Co., Ohio.
Carl Otterling, Orebro, Sweden.
Oscillating Churn.
Butter Workers.
P. Shaw, Scituate, Massachusetts.
P. Embree & Sons, West Chester.

Class 680.—Laying out and improving Farms.

Under this head a few of the more prominent inventions specially designed with a view to economise labour may be mentioned. The Americans have not as yet called in the aid of steam power to assist in the clearing of forest land, but several Manual Root and Stone Extractors were shown. That by A. C. Cotton, of Vineland, New Jersey, combines the ratchet wheel and lever, thereby ensuring safety and gaining great power with a slow motion. The chain to which the root or stone is attached is secured on a sproggle wheel, which is on the same axle as the ratchet wheel, so that slipping is impossible. The machine is fitted with a single lever, and can be worked by one man. The object can be raised sufficiently high to get a sledge under. The machine shown by C. M. Bowen, of Maine Avenue, New Jersey, is operated by a double leverage with dogs. The fulcrums are 1½ inches, and each lever is capable of raising 15 tons. This is a very efficient machine, but there is some risk of slipping, which is impossible in the first described. A self-loading Soil Excavator, exhibited by P. J. Strykers, of New Brunswick, demands notice. The excavator, a strong steel scoop, is between the front wheels, and can be raised or lowered as required; behind the excavator is an elevator worked by chain gearing from the hind wheels. The soil is conveyed by the elevator into the

Manual Root and Stone Extractors.
A. C. Cotton, Vineland, New Jersey.
C. M. Bowen, Maine Avenue, New Jersey.
P. J. Strykers, New Brunswick.

cart or receptacle, which has a hinged bottom in three divisions. The driver's seat is immediately over the elevator, and is within reach of a lever handle, by which the hinged bottom can be opened and the load discharged. Several Ditching and Draining Machines were shown, of which that of T. F. Randolph, Morriston, New Jersey, appeared the most valuable, as by a moderate outlay of animal power the labour of draining can be much expedited. It comprises a powerful beam carried on four wheels; in the centre of this beam is the cutter wheel, so arranged as to take out a given depth at each revolution, and discharge the soil on each side clear of the drain; different sizes are made, that shown in the Agricultural Hall is for three horses, and is said to do the work of 20 men, making the drains 30 inches deep.

Ditching and Draining Machines. T. F. Randolph, Morriston, New Jersey.

The universal Fencing Machine of S. W. Hall, Elmira, New York, is a most valuable invention, comprising on one frame all the machinery required to prepare fencing materials out of rough wood. Thus we have a circular saw, a tenoning and reducing apparatus which prepares the rails for insertion into the posts, and a series of augurs by which the requisite number of holes are bored in the posts and countersunk. As soon as one set of holes is made the position of the post is changed, and a second set of holes, occupying intermediate spaces on the opposite side, pierced, which completes the operations; all that remains is to set the posts and drive home the rails. An ordinary fixed or portable engine supplies the driving power. The cost of the machine is 300 dollars, or 55*l.*, and it is said that two men and one boy can prepare from 50 to 80 rods of fencing per day. For large enclosures this machine is most valuable. A. C. Betts, of Troy, New York, exhibited an admirable Wood and Wire Fencing Machine, for making light temporary fencings for sheep. The wire is placed behind the machine on reels, a boy places the wooden uprights under the wire in the machine at the required intervals. The staples, which are hung upon inclined rods, come to their place over the wire and are driven into the wood by hammers regulated by cam-gearing. The distances can be placed at intervals of 6 or 12 inches; as made the fence is wound upon a barrel ready for transportation. It is said that two men and a boy can make 200 rods of fencing per day.

Fencing Machine, S. W. Hall, Elmira, New York.

Wood and Wire Fencing Machine, A. C. Betts, Troy, New York.

Messrs. Rhodes and Waters, Elyria, Ohio, showed a Manual Post-Hole Digger which appears suitable for putting down fence posts in clay or sand. It consists of a jointed digger. The blades, which should be steel-faced and concave on the inner face, are attached to double handles; whilst the hole is being made the workman keeps the handles close; when the soil is to be removed the handles are opened, which brings the blades together, their concave interiors forming the receptacle for the soil.

Manual Post-Hole Digger, Rhodes and Waters, Elyria, Ohio.

Class 683.—Miscellaneous.

Under this head are included a great variety of exhibits, all displaying ingenuity of construction and adaptability of purpose. It is only necessary to briefly allude to some of the more important.

Messrs. Boomer and Boschert, Syracuse, show power machinery for the manufacture of cider. The cylinder of the apple mill is furnished with a number of knives adjustable by two screws. The fruit is held up to the cylinder by a spring jaw, the pressure of which is adjustable. The fruit after passing through the mill falls into an open box divided into two compartments by a moveable door, so that the products can be delivered from either end to the press, which is of very powerful construction, consisting of a cross-screw with double leverage threads. The downward motion is slow, self-arresting, and rises five times as rapidly as it falls. Excellent machines for hand-power are shown by several firms. The mill portion comprises, first, an adjustable jaw and small feed roller; secondly, two horizontal rollers covered with projections on their surfaces, which are differently speeded; the fruit passing between is very effectually aqueezed. The press is worked by a powerful screw, to which the follower is attached or not, as is thought desirable; our description embraces the general features of the machines, which differ somewhat in detail. Meat and Sausage Choppers, Potato and Fruit Peelers, Ice Freezers and Refrigerators were largely represented, and gave evidence of great ingenuity of design. Fruit Drying Machines, principally from California, illustrated a large and grow-

Cider manufacture, Messrs. Boomer and Boschert, Syracuse.

Meat and Sausage Choppers, &c.

Fruit Drying Machines.

O. F. Tiffany, San Francisco.

ing enterprise. Noticeable for efficiency was that shown by O. F. Tiffany, San Francisco, in which the arrangements for the admission and regulation of hot and cold air were very excellent, the surface of the roof inside being so contrived as to form a vapour conductor, the moisture thus collected emptying into a conductor with a syphon spout filled with water, and thus preventing the escape of heated air. The sieves containing the fruit being on wheels can be readily removed or shifted from story to story by an elevator. In another large apparatus, shown by Jones Bros., Michigan, the draft of hot air is secured by a fan-driven by horse-power. The screens are in 10 sections, and the fruit is passed forward according to condition. Rapidity of action and economy in working are the chief points claimed by the inventor. The largest machine of this kind was shown by Geo. A. Dietz, of Chico, California, which has 420 feet of drying surface. The arrangements for regulating temperature and securing the circulation of hot air are admirable. The construction of Wind Engines has received much attention, and a large exhibition of machinery was shown. These inventions are valuable for pumping water, grinding corn, chaff-cutting, &c. We notice first the United States Wind Engine and Pumping Co. (Halliday's Patents). In this the engine comprises a number of sections on transverse axes. These are held straight to the wind by means of a balance lever weight behind the mill. When the centrifugal force overcomes the weight, the sections open so as to adopt the same direction as the wind, and consequently the mill is checked or altogether brought to a standstill, but so soon as the velocity decreases, which is instantaneous, the balance weight comes into play again. The sections catch the wind, and the consequence is that the mill runs steady in a high wind, and hence may be safely left to take care of itself—a point of great importance. Great improvements have recently been made by the use of small counter-balance weights on the sections themselves, giving the mill a greatly increased power. The disadvantage is the complication of parts requiring more attention in oiling, and some extra first cost. A simple but less powerful engine was that of the Eclipse Windmill Co., in which the rosette wheel is solid; a patent adjustable side-vane acts as an over-balance, and draws the sail away from the wind, but does not interfere with efficiency in a light wind, because before it can act it must overcome the leverage of a weighted arm, which is also adjustable. The engine can be instantly stopped by pulling down this lever, which brings the wheel edge to wind. This mill is very well made, and appears a cheap and valuable invention.

Jones Bros., Michigan.

Geo. A. Dietz, Chico, California.

Wind Engines.

United States Wind Engine and Pumping Co.

Eclipse Windmill Co.

E. Stover & Bros., Freeport, Illinois.

E. Stover and Brothers, Freeport, Illinois, also use the solid rosette, the wheel being dished inwards and strongly braced by the fellies, which are of round form. A balance weight is here employed to aid the vane in its action; when the force of the gale overcomes the weight, the wheel is brought edge to wind. The frame is made of four pieces of timber, bolted together after the manner of a camp stool. The turn-table sets on an artificial table with 16 chilled iron balls; this gives sensitiveness, and allows of a comparatively short vane being used. The vane beam has a spring clutch acting on the crank wheel, and stopping the motion entirely if required. This is a strong mill, suitable for a farmer's work. Lastly, Gammon and Dering, of Chicago, exhibited a Pumping Engine, with the rosette in six sections actuated by a spring leverage, which causes the sections to open. The stroke is variable, according to the force of the wind. This is effected by having the crank shaft bent and acted upon by a spring on the rosette standard. When the wind is strong the crank is forced back and the stroke is affected. The connecting rod is attached to the crank by a ball and socket adjustment. This is a highly ingenious arrangement. I had no opportunity of seeing the engine in a high wind, and, therefore, refrain from a decided opinion as to its utility.

Pumping Engine, Gammon and Dering, Chicago.

Machine for making Horse-shoes, H. Burden and Sons, Troy, New York.

Mention should be made of a very beautiful working Model shown by H. Burden and Sons, Troy, New York, of their Machine for making Horse-shoes. The bar metal is fed into the machine by fluted rollers. First, the iron is cut off at the proper length, then the shoe is formed, next stamped between two dies. The holes for the nails are not punched, but a creasing die marks the spots where they are to be made. Lastly, the shoe is straightened by a press and discharged. Sixty shoes can be made in a minute. Though so efficient, the machinery is of simple construction. There were no entries under Classes 690 to 692.

In the above report I have endeavoured to describe some of the more important exhibits, so as to convey an idea of the comprehensive and varied character of the display, which in the American and Canadian sections was particularly admirable.

JOHN COLEMAN,
Riccall Hall, York,
English Judge of Agricultural Machinery at the Philadelphia Exhibition.

To Colonel H. B. Sandford, R.A.,
Executive Commissioner,
British Section.

SIR WILLIAM THOMSON, LL.D., D.C.L.

ELECTRIC AND TELEGRAPHIC APPARATUS,
INSTRUMENTS OF PRECISION,
RESEARCH, &c.

REPORT on "ELECTRIC AND TELEGRAPHIC APPARATUS," Sub-division of "INSTRUMENTS of PRECISION, RESEARCH, &c." at the CENTENNIAL EXHIBITION, PHILADELPHIA, 1876. By SIR WILLIAM THOMSON, LL.D., D.C.L., F.R.S., Professor of Natural Philosophy at the University of Glasgow.

SIR,

THE Centennial Exhibition of Philadelphia contained abundant evidence that the century which it commemorates has been well spent by the new nation in respect to scientific education and the advancement of science.

Geodesy.

No European nation has done better work in respect to Geodesy on a great scale than that of the United States Coast Survey. A fitting memorial of its labours,—a specimen of the measuring rods used in measuring the great base lines of Maine, Long Island, and Georgia, was exhibited in the United States Government Department of the Exhibition. Not the least valuable result of the organization arranged by Bache for the United States Coast Survey was the scientific training which it afforded to a large number of able men, naval and military officers and civilians, whence has sprung up in America a school of astronomers and astronomical mathematicians of whom any nation might be justly proud. Another result, also of very great value, is the impulse which it gave to the construction of optical and other astronomical instruments, for which America has now become celebrated, and which I believe was well represented in the Centennial Exhibition.

Readiness in the United States to adopt new ideas.

The readiness of the scientific departments of the United States Naval Administration to test reasonable suggestions from without, and to adopt them if found good, is illustrated by their Exhibition including my pianoforte wire apparatus for deep sea soundings, with important improvements made in it by Commodore Belknap. This apparatus, I was informed, is now on board a large number of vessels of the United States navy not specially appointed for surveying work, but ready with the apparatus at any time, and in whatever part of the world they may be, to obtain at infinitesimal expense, whether of material or of labour, results which cannot but be valuable both for science and for practical navigation. Their example might be suggested, as worthy of consideration, to the corresponding departments of our own service, whose unwillingness to leave a beaten track, though to a certain extent proper, indeed necessary, in public service, is often carried to such an extreme as to be advantageous neither in point of economy nor of efficiency.

Electric and Telegraphic apparatus.

The particular department assigned to me by my colleague judges of Group XXV. was Electric and Telegraphic Apparatus, in which I had the privilege and benefit of being associated with Professor Henry. The leading part early taken by America in electric science and its practical applications, through the electro-magnetic discoveries of Henry and their application to telegraphic signalling by Morse, has been worthily followed up in the great development of telegraphy and of other useful applications of electricity, illustrated by a great variety of objects in this group of the Exhibition.

Patent system in America

Looking, not merely to the telegraphic group, but to practical applications of science generally in the United States Departments of the Exhibition, no one can fail to be struck with the great and successful activity in the application of science to useful purposes in America. Thoroughly in harmony with this very valuable development of national energy, was the exhibition, in the United States Government Building, of objects illustrating the efficiency of the Washington Patent Office. Judged by its results in benefitting the public, both by stimulating inventors and by giving a perseveringly practical turn to their labours, the American patent law must be admitted to be most successful, and the beneficence of its working was very amply illustrated throughout the American region of the Exhibition, where, indeed, it seemed that every good thing deserving a patent was patented. I asked one inventor of a very good invention, "Why do you not patent it in England?" He answered, "The conditions in England are too onerous;" meaning, no doubt, that the cost of a patent in England is too great, and the time for which it is granted too short. It is not merely on account of the extreme injustice of such an enormous tax upon inventors as is implied in the 175*l.* of Government stamp

compared with that of England.

duties, charged according to our present law, that a diminution to something nearer the American charge of $35 is urgently needed. England undoubtedly loses much of the benefits which might be had from the inventiveness of Englishmen through the want in English patent law of encouragement and protection to inventors unsupported by capitalists.

Judges, group XXV.

For details regarding the objects which I specially examined I may be permitted to refer to my awards and reports, thirty-six in number, which were issued with the approval of, and which I submitted to, the judges of Group XXV., consisting of the following gentlemen:—

Professor Joseph Henry, LL.D., Secretary of Smithsonian Institute, Washington, D.C., U.S.A.
Professor F. A. P. Barnard, S.T.D., LL.D., Columbia College, N.Y., U.S.A.
Professor J. E. Hilgard, President, Washington, D.C., U.S.A.
Professor J. C. Watson, Secretary, Ann Arbor, Michigan, U.S.A.
General Henry K. Oliver, Salem, Massachussetts, U.S.A.
Mr. George F. Bristow, New York, U.S.A.
Sir William Thomson, LL.D., D.C.L., F.R.S., Professor of Philosophy, University of Glasgow, N.B.
Herr Julius Schiedmayer, Germany.
Monsieur M. E. Levasseur, France.
Herr P. F. Kupka, Austria.
Monsieur Ed. Favre Perret, Switzerland.

Feature of Judges' Report.

As to the new and characteristic feature of the Centennial Exhibition, according to which each award appears with a report signed by one or more of the judges on whose individual responsibility it is given with the approval of the judges of the group, I may be allowed to say, that, so far as I had opportunities for forming an opinion, this system worked well, and that it is very well adapted to secure, as far as rule and method can secure, good and useful judgments on the objects exhibited.

Concluding remarks.

In conclusion, I may be allowed to say that it was very gratifying to English visitors to find the industries of England and the British Colonies so well represented as they were in the Centennial Exhibition, and to discover how heartily this British coöperation in their great work was appreciated by the citizens of the United States. The early completion, the excellent arrangements, and the interesting character of the English Department of the Exhibition, were subjects of general remark, and much credit is due not only to British Exhibitors but to the British Commissioners, both at home and in Philadelphia, to whose good management this gratifying result is in large measure attributable.

WILLIAM THOMSON.

The University,
Glasgow, Dec. 20th, 1876.

To Colonel Sandford, R.A.,
Executive Commissioner
for Great Britain and Ireland.

SIR JOHN HAWKSHAW, C.E., F.R.S.

ARCHITECTURE AND ENGINEERING.

REPORT on "ARCHITECTURE and ENGINEERING," as displayed at the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By SIR JOHN HAWKSHAW, C.E., F.R.S.

33, Great George Street, Westminster,
14th December 1876.

SIR,

IN accordance with your request I have now the honour to report, for submission to the Lord President of the Council, the broad features of my particular section of the Philadelphia Exhibition.

Civil Engineering and Public Works.

In the capacity of one of the judges my functions at the Exhibition were confined to Civil Engineering and Public Works, and in the division of labour agreed to among the judges of that class it fell to my lot to report on so much of it as related to the United States and to Great Britain, the works of other countries being allotted to other judges.

Judges.

The following is the complete list of judges for Section XXVI :—

General William B. Franklin, President, Hartford, Conn., U.S.
Edouard Lavoinne, Secretary, France.
J. M. Da Silva Continho, Brazil.
James B. Eads, C.E., South Pass Jetty Works, 122, Common Street, New Orleans, La., U.S.
T. G. W. Fynje, Netherlands.
Sir John Hawkshaw, C.E., F.R.S., Great Britain.
Richard M. Hunt, 49 West 35th Street, New York, U.S.
Lourenco Maheiro, M.E., Portugal.
Colonel George E. Waring, Junr., Newport, R.I., U.S.

Preliminary remarks.

Some branches of Engineering as Motors, Railway Plant, &c. were classed under other heads and allocated to other gentlemen who will, I presume, report upon them. Civil Engineering and Public Works could not without great labour and expense be fully illustrated in any Exhibition, and engineers who have to deal with such works have usually their time too fully occupied to say much about them either during their progress or afterwards. Partly perhaps from these causes Great Britain, though not unduly represented in the Exhibition in some other departments, was, as it regards Civil Engineering and Public Works, hardly represented at all. Some other countries, Holland for example, owing probably to the public works of that country being more under the control and supervision of the Government, were at its instance much more amply represented.

Great Britain.

Holland.

United States.

The superintendence of engineering works in the United States is of a more mixed character; while some of the largest and most important works in that country are performed by Civil Engineers, there are many works on the coast and in its rivers which are executed by the Corps of Engineers of the United States army. This appropriation of engineering work to military men arises probably from the circumstance that, though the number of rank and file in the United States army is small, there is a desire to maintain a large staff of officers, many of whom are thus employed. From this circumstance probably a more copious illustration of engineering works was exhibited by the United States Government. The civil engineers of that country in some cases sent to the Exhibition no account of some very important works, but after my labours at the Exhibition had ceased, I took the opportunity of visiting and inspecting some of those works, and the remarks which follow therefore must be taken in some cases to illustrate what I observed on the spot, or on which I acquired information in other ways as well as what I examined in the Exhibition.

RIVERS.

Hell-Gate.

Under this head the operations for the removal of the reef at Hallett's Point, Hell-Gate, New York, are remarkable for originality and boldness. The reef projects into the channel at Hell-Gate about 300 feet. The depth over it for the distance of 270 feet from the shore is at low water less than 12 feet. The channel there being narrow and crooked, the object of this improvement

is to widen and straighten it by securing a minimum depth of 26 feet of water over the reef.

Commencement of work.

The work was commenced in July 1869 by building a coffer dam between high and low water marks. In October following the excavation of the shaft was begun. From the bottom of the shaft 10 tunnels were driven under the river in radial lines and were extended until a depth of water upon the reef of 26 feet at low tide was reached, the roof of the excavation being kept nearly parallel to the bed of the river and about 10 feet below it. The main tunnels are about 14 feet in width, varying from 10 to 20 feet in height and averaging about 270 feet in length. They are connected with each other at intervals of 30 feet by means of cross tunnels or galleries of about the same height and width. Between the tunnels and galleries large columns of solid rock were left to support the roof of the excavation or bed of the river; these large columns were afterwards cut through by other tunnels and galleries, and finally 173 piers or columns were formed, averaging about 10 feet each in thickness. The entire roof thus undermined covered an area of three acres. The aggregate length of tunnels and galleries driven under the bed of the river was 7,425 feet. From the excavation about 47,460 cubic yards of rock were removed by drilling and blasting, an operation which required 208,174 lineal feet of drill-holes, of which 90,107 feet were drilled by hand and 118,067 feet by various kinds of machine drills, viz., The Burleigh, Diamond, Rand, Winchester, Wood, Ingersoll, and Waring drills, worked by compressed air.

Plan of operations.

Extent of tunnelling.

Modus operandi.

The usual method of driving a tunnel or gallery was as follows: the face of the rock was pierced obliquely with as many drill-holes from 3 to 4 feet in depth as were deemed necessary; the charges were then prepared by placing the explosive material in water-tight paper cartridges from 8 to 12 inches long and containing from 8 to 12 ounces of explosive mixture; into each of these cartridges a copper cap containing mercury fulminate fastened to the end of a piece of safety-fuse, generally about 5 feet in length, was inserted. The cartridge was then pushed to the bottom of the hole, which was filled with water; the ends of the fuses hanging from the drill-holes were then ignited.

Quantity of explosives used.

In the preliminary operation of forming the tunnels and galleries the following quantities of explosives were used:—

Blasting powder	24,431	pounds
Nitro-Glycerine	26,471	„
Giant powder	1,932	„
Mica powder	600	„
Vulcan powder	4,017	„
Rend Rock	1,500	„

In exploding these compounds 63,756 exploders and 331,516 feet of Bickford's safety-fuse were used. In all about 75,000 blasts were fired.

Model.

A good model showing the tunnels and galleries and the pillars left to support the roof was sent to the Exhibition. When I visited the work at the beginning of August last holes had already been drilled in the pillars and roof to receive the explosives for the final explosion. These were intended to be charged with nitro-glycerine cartridges to be connected by wires with a battery to be placed at sufficient distance. It was intended before making the discharge to fill all the tunnels and galleries with water. The explosion took place a few weeks after I left. To complete the work the debris will have to be removed.

It will be interesting to learn, when the work has been completed, what has been the total cost to compare with the probable cost of reducing the shoal by the more usual method of submarine blasting. The excavation of another reef in the channel, the Flood Rock, has already been commenced upon the same principle as applied at Hallett's Point. While on this subject, it may be useful here to mention a machine used in the United States in removing reefs and rocks under water by blasting from the surface, and which is described as follows.

Similar works at the Flood Rock.

Steam Drilling Scow.

Float or scow.

The machine consists of two parts, a large float or scow having a well-hole in it of a diameter of 32 feet. It is built very heavy and strong, and is provided with an overhang or guard around it faced with iron, and has proved itself up to this time capable of withstanding violent collisions with other vessels.

Besides affording this security it serves also to transport the caisson or dome from place to place, and is a working platform from which the drilling engines are operated. The caisson or dome is a hemisphere of the diameter of 30 feet, composed of a strong iron frame covered with boiler iron. The dome is open at bottom and at top, and is provided at the bottom with legs to support and level it, which are arranged to let go altogether after the dome is lowered. **Caisson or dome.**

The hemispherical shape of the caisson is favourable to stability. The caisson or dome is simply a framework affording a fixed support to 21 drill tubes, through which the drills operate. The dome is connected with the scow by four chains communicating with four hoisting engines, by which it is lowered or raised. A framework is built upon the scow around the well-hole to support the carriage holding the drill engines, which by these means may be placed directly over the drill tubes. The engines simply raise the drill rods, and allow them to fall by their weight upon the rock, the vertical play being 18 inches; the drill and drill rods together are about 10 feet long, and weigh from 600 to 700 lbs. The cutting edges are in the form of a cross, and are $5\frac{1}{2}$ inches long. **Details.**

The scow having the dome swung by chains is first anchored over the rock to be operated upon, so that the bow and aft moorings pull against the direct currents of the ebb and flood tides, but as these may vary somewhat in direction from one tide to another, as well as during the course of the same tide, it becomes necessary, in order to steady the scow, to have side anchors also. The diver descends to ascertain whether the location is well suited to placing the dome on the bottom, and if not, to select a better. The required change in the position of the scow is made by lengthening and shortening the mooring chains with capstans, which are arranged to be worked at will with steam or man power. The dome is then lowered, and when it touches or approaches near the bottom the legs are let go, and being held by self-acting cams support the weight of the dome. The chains are now unslung from the dome, which is thereby without connection with the scow. The diver descends to ascertain which of the drill tubes it is necessary to use to break up the rock within the dome, and how the surface offers itself to each particular drill. The drill rods being introduced within the drill tubes, which is easily effected during the most violent currents, a rope or other flexible connection is now made between the top of the drill rod and the piston rod of the drilling engines. A flexible connection is necessary to the act of drilling, as in this machine, the dome remaining fixed upon the bottom in one position, while the scow holding the drill engines swings for short distances from changes in the directions and strength of the currents, no rigid connection between the engine and drills would be practicable. The length of the rope attachment is regulated by a feed-gear for the rise and fall of the tides and continual changes of water-level. **Method of employing it.**

The drilling being completed, preparations are made for charging the holes with nitro-glycerine. The chains are hooked on the dome, which is then raised from the bottom, and the scow swung off from the spot to a safe distance without casting loose the moorings. This distance will depend upon the proposed amount of charge of nitro-glycerine, and will vary from 175 to 350 feet. The nitro-glycerine, in tin cases of different lengths, to suit the varying depths of the drill-holes, is carried to the spot upon a small scow, from which the diver descends to the first hole to be charged. He is guided to this by a line. Withdrawing the plug, he introduces into the hole the tin cartridge, which has been filled by the men on the scow and passed down to him. Each cartridge is attached before it is sent down to the wires. The diver then passes on to the second hole, guided by the plug-line which connects the stoppers of the adjacent holes, and in this way the whole circuit of holes is visited and charged. The leading wires are connected with the battery, when the small scow has been withdrawn, and the explosion is made. **Blasting operations.**

To break up the rock thoroughly the drill-holes should be from 6 to 8 feet apart, of the size of $5\frac{1}{2}$ inches at the top, and charged with amounts varying with the depths of hole, which will average between 50 and 60 pounds for each, and the depth to which the drill-hole should reach below the level to which it was desired to break the rock is about four feet.

After the rock broken by the explosion covers the greater part of the reef its removal is commenced. This is effected by means of a steam grapple.

Way's Reef, Cerentie's Reef, Diamond Reef, Frying-pan and Pot Rock.

By this machine Way's Reef at Hell Gate, and Cerentie's Reef in East River, have been removed to the depths of 26 and 25½ feet respectively. It has also operated upon Diamond Reef, East River, and Frying-pan and Pot Rock in Hell Gate, and removed portions of those reefs.

A channel has been cut by the same machine through a reef in the Haarlem River.

The Mississipi.

Another very interesting engineering work is now in progress with a view to improve the entrance to the Mississippi.

Channels.

The waters of that river, estimated to amount to 1,280,000 cubic feet per second, find their way through the Delta into the Gulf of Mexico mainly through three channels or passes, viz., the South-west Pass, the South Pass, and the Pass a l'Outre; the centre or South Pass hitherto has not been used for conmerce, and though it is the most direct passage, yet before the works began not more than about one-tenth of the waters of the Mississippi found their way through it to sea. The object of the works, which are now in rapid progress, is to improve this outlet which in its original state at high tide had not more than 8 feet of water on its bar, and to secure if possible everywhere along it a depth of 20 to 26 feet. With this object, jetties 1,000 feet apart, formed of mattresses covered with stone, are being constructed on each side of the channel, and the result of this work is awaited with great interest, for if successful it will be of vast importance to the traffic of that great river, and will produce changes in the direction of traffic to and from this vast Continent difficult at present to estimate.

Jetties.

Harbours.

The magnitude of the Lakes and Rivers, of sheltered Bays and arms of the Sea, have spared the United States the necessity of constructing deep-sea artificial Harbours like those which have in some cases in England, as at Holyhead and Portland, for instance, involved so much expenditure.

Harbour of Refuge.

But some of the American Lakes are like inland seas, and sometimes call for works of magnitude such as the Harbour of Refuge now constructing in Lake Huron, where the Breakwater will be 7,000 feet long, and will enclose an area of 320 acres of 12 feet water.

The method of constructing this and other Breakwaters, much used in the country, is called crib-work. It consists in forming boxes or frames of timber of the width of the structure required, and of convenient lengths and divided into compartments. The frames are floated to their place, then sunk and afterwards filled with stone. Where necessary, in very exposed situations they are protected outside by stone or *pierre perdu*.

Models.

Of the Models exhibited of similar works may be mentioned, details of Crib-work used in the Breakwater, Oswego Harbour, Lake Ontario, New York; model of Crib-work used in the construction of United States Breakwater at Dunkirk, New York, Lake Erie.

Lighthouses.

Many Models of these structures, varying in material and mode of construction, were exhibited by the Government of the United States, with samples also of beautifully constructed lenses of each class.

Meriolo Ledge.

One of the best specimens of Lighthouses is that on the Meriolo Ledge, at the entrance to Boston Bay, visible 16 miles, with a second order lens, and furnished with fog-bell struck by machinery. This Lighthouse stands in 12 feet of water at high tide, and is built of granite. Its base for a considerable height is solid, the lower courses of stone being bonded by a system of dovetailing, differing from that of the Eddystone or Bell Rock Lighthouses, but sufficiently effective for its situation.

Models of other forms of Lighthouses were exhibited, of which I may mention—

Spectacle Reef.

The Stone Lighthouse built on the Spectacle Reef, Lake Michigan, visible 16¾ miles, alternate red and white light, furnished with a 10-inch steam whistle.

Alligator Reef.

The Iron-pile Lighthouse on Alligator Reef, visible 18 miles, lens of 1st order

The Iron Lighthouse on Coffins Patch, Sambroro Shoal, Florida Reef, lens of 1st order. Coffins Patch.

The Iron Screw-pile Lighthouse on Brandywine Shoal, Delaware Bay, lens of 3rd order, furnished with fog-signal bell. Brandywine Shoal.

The Lighthouse, an Iron Tower 83 feet high, on the north pier of Chicago Harbour, visible 16 miles, lens 3rd order. Chicago Harbour.

The vast extent of coast required to be lighted in the United States, which, including Ocean, Bay, Lake, and River, without including the Pacific Coast, amounts to more than 5,000 miles, requires numerous lights, and the number of Lighthouses under the charge of the Lighthouse Board of the United States, including 36 on the Pacific Coast, amounted in 1875 to 639. The number of Light-ships was 23. Number of Lighthouses and Light-ships.

Bridges.

The magnitude of the Rivers and the skill and boldness of the engineers have led to some remarkable specimens of Bridge building in the United States.

The well-known Suspension Bridge, 800 feet in span, erected over the River St. Lawrence some years ago, is being far surpassed by a suspension bridge now building over the East River, to connect New York and Brooklyn. Over a whole length of 3,455 feet a Bridge will be suspended in three main openings. The central span will be 1,595 feet from centre to centre of Tower, and the side spans, measuring from the centre of Tower to the face of the anchor walls, will each be 930 feet. River St. Lawrence. East River.

The Roadway which the Bridge is designed to carry will pass the Towers at an elevation of 119 feet, and in the centre of the main span the elevation in the clear will be 140 feet above low water. Roadway.

The suspended superstructure will consist of an iron framing, 85 feet in width, suspended from four main cables by wire ropes attached to iron floor beams placed 7 feet 6 inches apart. The flooring is further to be divided into five spaces by six lines of iron trusses, of which the two centre trusses have a depth of 12 feet, and the others of 8 feet. Construction.

The outer spaces have a width in the clear between the trusses of 18 feet, and each will accommodate two lines of iron tramways for ordinary street traffic. The next two spans, 13 feet 2 inches wide, will be provided with iron rails for running two passenger trains to be worked by a wire rope.

The Bridge is to be supported by four main cables, two outer ones and two near the middle of the flooring. The Cables, of which a specimem was in the Exhibition, will be 16 inches in diameter, composed of galvanized tempered cast-steel wire, No. 6 gauge, having a strength of 160,000 pounds per square inch of section. The Cables are to be aided by a system of 104 stays in each quarter, which are together assumed to be capable of upholding the superstructure of the main span, the aggregate weight of which, inclusive of cables, will be 5,000 tons. Supports.

Another illustration of Bridge building on a grand scale is the Illinois and St. Louis Steel Arched Bridge, spanning the Mississippi at St. Louis—a work remarkable for boldness of design and for originality in the mode of construction. This Bridge has three main arches of large size. The central arch has a span of 520 feet, with a versed sine of 47 feet, and two arches, one on each side the central arch, have spans of 515 feet. Each of the three arches consists of four ribs about 12 feet deep, the top and bottom of each rib being steel cylinders, 18 inches in diameter, 2 inches thick at the skew-back, and $\frac{7}{8}$ths of an inch thick at the soffit. These are connected and braced together also by cylindrical tubes. The bridge carries a Roadway on the top and a double line of Railway beneath. The segments of the ribs as the erection advanced were supported by overhead guys passing over temporary towers erected on each pier and abutment, so that all scaffolding, centering, or supports from below were dispensed with. The Raritan Bay Swing or Pivot Bridge, of which a model was exhibited, is a good illustration of a large bridge of another class. The moveable part of the bridge is 472 feet in length, leaving, when the bridge is swung open, clear waterways on each side of 220 feet. St. Louis Steel Arched Bridge. Raritan Bay Swing Bridge.

The largest Iron Truss Bridge at present in use in the United States seems to be the Newport and Cincinnati Bridge, the channel span of which is 420 feet, Newport and Cincinnati Bridge.

but larger bridges of this class are already projected. One proposed to be built over the Hudson River at Poughkeepsie, N.Y., will have five spans each of 525 feet.

Washington Aqueduct.

Some years ago a Stone Arch having a span of 220 feet and a versed sine of 56¼ feet was built on the Washington Aqueduct, and on the same aqueduct an iron bridge was built 200 feet in span with a versed sine of 26 feet, in which the segmental ribs which form the arch consist of iron pipes 4 feet in internal diameter, through which the water flows that supplies the City of Washington. The bridge so built carries a roadway, an ingenious device, which makes water-pipes serve two important purposes, neither of which interferes with the other.

Girard Avenue Bridge.

Croton Aqueduct.

Lake Michigan Water Works.

I am unable within the limits of this report to do more than to illustrate by a few prominent specimens the magnitude and importance of the Engineering works of the United States. The Girard Avenue Bridge, across the Schuylkill at Philadelphia, is a fine structure, equal in size to the largest bridge across the Thames. The Croton Aqueduct for supplying New York with water is worthy to be compared with those of Ancient Rome, and the Tunnels driven under Lake Michigan at Chicago to draw water from the lake free from the pollution of the shore for the supply of that city is another work worthy of mention.

Early Iron Bridges.

The Southwark Bridge, across the Thames in this country, the Tubular Bridge, across the Menai Straits, and the Saltash Bridge, spanning the Tamar at Plymouth, were in their day the largest iron bridges then constructed. So late as 1862 no Iron Girder or Truss Bridge in the United States probably had a larger span than 200 feet. The great advance in the size of structures that has since been made will appear from the few specimens of bridge building which I have given.

Mere size, however, is not of itself indicative of science or skill, which in every work can only be measured by a just appreciation of the end aimed at, of the difficulties to be overcome, and of the ability displayed in surmounting the one and in securing the other.

From the magnitude and number of the public works in the United States, however, other lessons may be learned than those which tell only of the science and skill of its engineers. From what I have seen they possess enough of both to fit them for the accomplishment of any works they are likely to undertake.

Extent of Railways.

The 70,000 miles of Railway already constructed, the ramification of the Electric Telegraph, and its application to uses more extended and varied even than in our own country, the crowd of Steamboats wherever navigation is possible and public convenience can be promoted, the building of cities like Chicago, which, after the great fire, in four or five years has arisen out of its ashes a more beautiful city than before—all these tell of the increase of wealth, and speak still more strongly of the public and patriotic spirit of the people.

Comparative estimate of progress.

To me, who visited the United States on a former occasion, but so long ago that Chicago was then but a village, and Philadelphia had not more than one half its present population, when its railways were only beginning to be made with wooden bridges and almost temporary works, when its vast mineral wealth was nearly untouched, and wood was burned where coal is now consumed, the astonishing changes, and the vast progress since made, appear greater than perhaps they will do to others whose visits have been more frequent. However this may be, what I witnessed at the Exhibition at Philadelphia and in the districts I visited impressed me very strongly with the energy of the people and the vast resources of this great country.

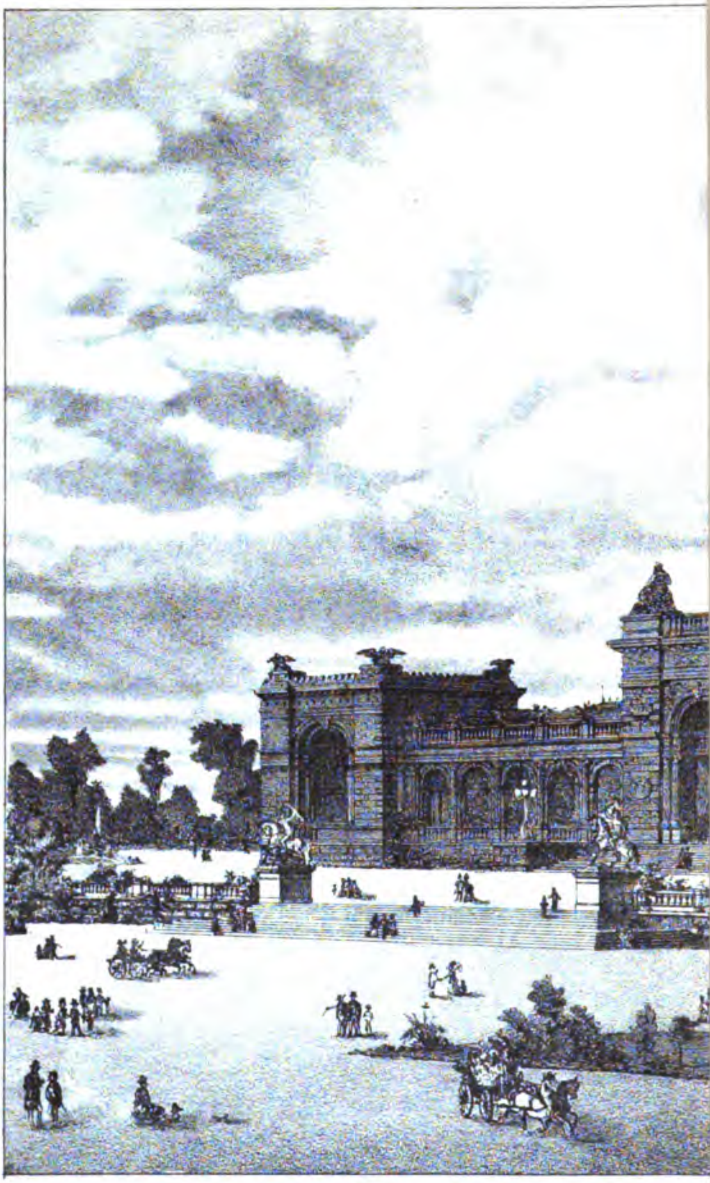
I have the honour to be,

Sir,

Your very obedient Servant,

JOHN HAWKSHAW.

Colonel Herbert B. Sandford, R.A.



Length. 365 ft. } *Area.*
Breadth 210 ft. } 76,650 sq. ft. *Floor, or Horizontal*
Height 59 ft. 88,869 sq. ft. *Vertical or Wall*

IN

FAIRMOUNT PARK

Mr. CHARLES WEST COPE, R.A.

PLASTIC AND GRAPHIC ART.

REPORT on the SECTION of "PLASTIC and GRAPHIC ART" at the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By CHARLES WEST COPE, Esq., R.A.

19, Hyde Park Gate South, London,
August 7th, 1876.

MY LORD DUKE,

I HAVE the honour to submit the following report upon the Centennial International Exhibition in Philadelphia, as far as relates to the duties confided to me by your Grace, as one of the "Judges" on "Plastic and Graphic Art," Group 27.

The Judges were 21 in number:—

Number of Judges, eight Americans, thirteen Foreigners.

AMERICAN.

F. H. Smith,	Boston, Massachusetts.
J. Taylor Johnston,	New York.
J. L. Claghorn,	Philadelphia.
Professor J. F. Wier,	New Haven, Connecticut.
Brantz Mayer,	Baltimore, Maryland.
Donald G. Mitchell,	New Haven, Connecticut.
G. W. Nichols,	Cincinnati, Ohio.
Professor Henry Draper,	New York University, New York City.

FOREIGN.

Chas. W. Cope, R.A., Peter Graham,	Great Britain.
Carl Schlesinger, Dr. H. W. Vogel,	Germany.
Emile T. Saintin,	France.
Fritz L. von Dardel,	Sweden.
P. N. Arbo,	Norway.
Conde de Donadio,	Spain.
Tantardini, G. de Sanctis,	Italy.
Carl Costenoble,	Austria.
Professor Dahlerup,	Denmark.
J. E. Heemskerck van Beest,	Netherlands.

Division into classes.

At the first meeting of the committee of "Judges" it was determined to subdivide the group into six classes:—1, Sculpture; 2, Painting; 3, Engraving and Lithography; 4, Photographs; 5, Industrial Designs, Models, and Decoration; 6, Decoration with Ceramic and Vitreous Materials, Mosaic and Inlaid Work. By this proceeding progress was facilitated, and judges were selected according to their respective fitness as "experts" in the respective classes. They were empowered to propose awards of medals. These awards were afterwards submitted to a committee of the whole group, and required confirmation by a majority of signatures in support of the name proposed. Thus a certain amount of responsibility for the award made, rested on each individual judge.

Class of Painting.

"Uniform Bronze Medals."

I will now make a few remarks upon the class of "Painting," to which I was appointed, and of which I was elected chairman. At the very outset of our labours it was generally agreed that the regulations prescribed by the Centennial Commission for the award of "equal" Bronze Medals, accompanied in each case by a certificate, descriptive of the particular merits of each work, were inapplicable to works in the fine arts. It was soon found that it was impossible to get a jury to agree upon the exact reasons (which indeed are often undefinable) for preferring one work of art to another. In a mechanical invention such a description is both possible and useful, and is to the inventor

of great pecuniary value; but this is not the case in works of fine art, the peculiar merits of which, like the scent of a flower, cannot be so easily defined. It was therefore resolved to omit, in the case of pictures, any particular description, or "reasons," and to substitute instead a general expression of "Excellence in Art."

Division into grades.

Another difficulty presented itself at the outset. It was felt that the high qualities of mind, the elevation of treatment, the correctness of design, and frequently the learning, necessary to produce a great work of art, were very different from those required for the representation of "still life," or for those reproductions which require little effort beyond patience or technical skill.

After considerable discussion it was resolved, unanimously, to divide "Painting" into "grades," so that while the general principle of "equal" medals was retained, the distinction of gaining a medal in the most elevated branches of art would be greater than that of obtaining one in the least difficult. Painting was therefore divided into these following heads:—

1. Poetic, religious, or historic art.
2. Genre, or scenes of familiar life.
3. Portraits.
4. Landscape and marine.
5. Animals and still life.

Nationalities not to be considered.

The question was asked, whether the "Judges," in recommending these awards, were to be influenced by or make allowance for the comparative youth of a nation; *e.g.*, the empire of Brazil, or Canada? The director replied that the judges were to regard *merit* alone, and in no degree to consider nationality.

Modes of procedure in voting the awards.

The system adopted by the sub-committee on painting was as follows:—each member proposed in turn the name of a painter, and the work to which a medal should be awarded; a vote was then taken, which was decided by a majority of votes, the chairman not having a casting vote. These general principles being decided on, the various sub-committees commenced and continued their labours, meeting daily to record votes. The whole "group" met in committee from time to time, to receive the reports of the sub-committees, and to confirm or reject the awards proposed. This was continued "de die in diem," until the pictorial matter was considered exhausted; but in order to avoid any possible unfairness or accidental neglect, it was agreed to re-examine the whole collection, and meet again, when each member had the privilege of either re-proposing former names which had been unfortunate, or naming new ones. A final report was then agreed to, and the committee passed a resolution "to adjourn."

Composition of the "Judges."

The judges consisted of eight painters, two sculptors, one architect, one photographer, one inspector-general of buildings, one director of fine arts, one employer in industrial design and decoration, and four "lay element" representatives (a banker, authors, writers, &c.).

The comparative number of medals awarded to each nation for painting is as follows:—

Number of medals awarded to each Nation.

United States, 13; Austria, 7; Belgium, 2; England, 13; France, 16; Germany, 7; Italy, 4; Netherlands, 6; Norway, 3; Spain, 6; Sweden, 2.

Change in the direction of art.

A slight general statement with regard to the paintings exhibited by each nation is prefixed to the report of the general committee on the awards; it is therefore unnecessary to repeat it here. But I would venture to remark generally, with regard to the Exhibition as a whole, that a change has come over its *direction* in many respects: there is very little indeed of the severely classical. The alterations that were made some years ago in the French Academy, substituting the "romantic" for the "classical," have produced their inevitable results, not only in France, but throughout most of the continental schools; according to the prophesy of M. Ingrès, and the academicians who supported his views, there is a "decadence." Others may consider that the change has been beneficial, and that the hard severity of the school of David is well exchanged for greater freedom.

However this may be, there is no doubt that the present Exhibition shows an increasing tendency in the direction of modern life and history, genre, and landscape art; and there is less of the classical or mural simplicity of the old schools of France or Germany; the subjects chosen for painting are more

familiar and modern, appealing to the eye, and depending greatly for their success on the technical excellencies of colour, texture, and execution.

I wish, however, to mention a few of the more striking features of the Exhibition.

American art.

By far the most extensive collection of pictures was contributed by the United States, as indeed was to be expected. If the question be asked, "What is the character and quality of American art?" it is difficult to find an answer, because the visitor is puzzled by the great variety of aim and treatment. It is evident that the artists have mostly studied in the schools of Europe, and have returned home bringing with them French, Belgian, or English taste and methods, and frequently one finds that even the subjects chosen are rather European than national. Besides this, many foreign artists have gone to the States, have become citizens, and their works are ranked as American productions, although they are rather the works of foreigners. It is only fair, however, to say that there are many exceptions to this general remark, as there are some painters who have not been "inspired" solely by foreign influence. Perhaps this want of originality is unavoidable in a very young school, and there are not wanting evidences of home inspirations. These, however, are rather exceptional.

The most original, and therefore to foreigners most interesting, efforts are in the branch of landscape painting. There are many pictures representing the grand features and bold rocky scenery in the far West. These are very characteristic, but a critic perhaps might wish that they had less of the look of mere views, less deficiency in art language. Good art is not dependent upon fine scenery, nor is the finest art usually found in countries where the scenery is on the grandest scale, *e.g.*, Switzerland. The very grandeur seems to be a snare, enticing painters to attempt impossibilities. On the other hand, some of the finest efforts in landscape are to be found in Dutch art, where the only end is to represent the simplest truths of nature in colour, light, and shade.

France.

The French school of painting was inadequately represented, many of the leading French painters having contributed nothing. But the abstinence from exhibition by the painters was atoned for by the sculptors, for the bronze figures were among the most remarkable and beautiful productions in the whole collection, and received the warmest approbation.

Italy.

Not so, however, with the large majority of Italian pieces of sculpture. The art seems to have descended to mere materialism, the aim of the sculptors being to represent curious distinctions of surface texture, in cloth or linen or knitted fabrics; difficult under-cuttings of network enclosing fish, and such like trifles. The quantity of these works is surprising, suggesting the painful reflection that where there is such an abundant supply the demand must be considerable, and pointing to the conclusion that the art is debased into ministering to the tastes of the ignorant.

Austria.

The contributions from Austria were very striking in the direction of colour. Amongst them were some remarkable works, gorgeous in many-hued brilliancy, or subtle in refined delicacy.

Spain.

In religious art the noblest contributions were sent by Spain.

Engraving, &c.

The specimens of line engraving are very few, and it is to be feared that this noble branch of reproductive art is likely to die out. The improvements made in photographic processes, which can reproduce works in a short space of time and at comparatively little cost, are elbowing other kindred arts out of existence. The specimens of photo-gravure from pictures were very excellent.

Etching.

The art of etching, however, is well represented by exhibits from France, England, Austria, and America. It is an art adapted not only for reproducing the works of others, but in the hands of genius it is a fascinating method of expressing original thought and feeling, combining the utmost freedom with the subtlest delicacy. In France it is used as a means of illustrating books with original designs, and its consequent effect upon art is most advantageous.

Extra medals to Canada.

I was requested by the Canadian Commissioners to inspect the works of art contributed by the Dominion, and to adjudge extra awards specially given by their Government, consisting of Gold, Silver, and Bronze Medals. I had great pleasure in complying with their request. The collection was not very large. There were some very good busts; the best pictures were to be found amongst the landscapes.

British Collection.

I would add a few words only on the British collection of paintings. It seems to be universally conceded, that among the various nations which have contributed works of fine art, England stands conspicuously and honourably prominent. This generally expressed opinion is confirmed by the verdict of most of the Foreign as well as the American "Judges."

Government aid necessary.

The high position taken on this occasion by England is entirely due to the generous and enlightened action of the British Government, in not only undertaking to defray the great and unavoidable expenses connected with freight and insurance, but in soliciting contributions from the owners of fine works of art. Her Majesty contributed several important and valuable pictures, and her example was followed by a large number of the possessors of private picture galleries, as well as by distinguished artists. Without this liberality, English art would have remained unworthily, or very inefficiently represented. It is obvious, that private owners of very valuable works cannot be expected not only to lend their pictures, but also to undergo the risk of damage, and the expense of transportation. It may also be fairly hoped that the favourable impression made, and the admiration excited, will be ultimately beneficial to the artists themselves.

Contributions sent by the Royal Academy.

I may perhaps be allowed to add, in conclusion, that the collection of the Diploma works of deceased Academicians, contributed by the Royal Academy, was highly appreciated by the more enlightened citizens of the United States.

I have the honour to be,
My Lord Duke,
Your most obedient servant,
C. W. Cope.

To His Grace
The Lord President of the Council.

Postscript.

Since my return to England pressure has been brought to bear upon the Centennial Commissioners in Philadelphia to grant a large extension of the number of medals in the Fine Arts. The first notice I received of it was in a letter from the Secretary to the British Commissioners, written at the request of General Walker, Chief of the Bureau of Awards, to which I sent a reply. Both are printed below, Nos. 1 and 2.

The only other notice I have had is contained in a letter to the "Nation" newspaper, published in New York, also enclosed below (No. 3), written by one of the "judges of awards" in the Fine Arts. It gives a succinct account of the whole transaction. I make no comment.

C. W. C.

No. 1.

St. George's House, Fairmount Park,
Philadelphia, 15th August 1876.

Dear Mr. Cope,

A matter of very great difficulty and delicacy has arisen in connexion with the fine art awards, and, at General Walker's express wish, I write to you immediately on the subject.

It is right that I should say, at the outset, that I am quite certain there is the strongest feeling among the Chief Executive of the Exhibition, and more especially on the part of General Walker, that in no case should there be even the semblance of discourtesy to yourself.

It is proposed by the Centennial Commission—the supreme body here—to extend the area of the awards in the Fine Art group, without of course making the slightest change in the specific awards made by the Sub-Committee on Painting, of which you were chairman.

Thus instead of 80 awards it is proposed that there should be some such larger number as 200. General Walker states that in several groups the proportion of awards is 25 to 30 per cent., while in the painting group it is at present not 4 per cent.

The initiative in this new action proceeded, I am informed, from the unanimous feeling of nine of your colleagues who are still in Philadelphia, who expressed themselves as conscious that many meritorious pictures were necessarily excluded since the number of awards was so limited.

The General Direction coincided in the view taken, being anxious to recognise *elements of good work* as well as distinct excellence. They feel that for over 3,000 paintings 200 awards cannot be considered excessive, and it is assumed that the Fine Art Committee unintentionally, somewhat, misinterpreted the spirit of the system on which it was desired they would act by circumscribing so much their awards.

I should mention here that both Count Donadio and Mr. Schlesinger left letters with General Walker expressing their opinion that the scope of the awards ought to be extended, and stated that the only reason why they have not taken part in the further examination was that, as they had been members of the Painting Committee, and had acquiesced, though against their judgment, in the limitation of the awards to 80, they felt now a delicacy in joining their colleagues in further action.

General Walker feels himself to be in a dilemma. It seems to be a case in which the lesser of two evils should be taken: on the one hand, strongest feelings aroused by the paucity of Fine Art Medals; on the other, the unhappy necessity for acting in the absence of yourself, the chairman of the Committee for Painting.

General Walker emphatically repeated to me to-day that your absence, in the decision of this delicate question, has been specially felt; and he is most anxious to be assured that you are of opinion that the course taken has been the best possible under the circumstances.

I fear I have not been a very lucid chronicler of this complication. You will understand, of course, that the Foreign Commissioners whose countries have few awards, and who have managed, at this date, to ascertain the fact, are very irate. Two medals only to Belgium is severely felt; so that General Walker has literally been on the horns of a dilemma.

Believe me, &c.
A. J. R. TRENDELL.

Charles W. Cope, Esq., R.A.
&c. &c.

No. 2.

19, H. P., G. S.,
2nd September 1876.

DEAR MR. TRENDELL,

I AM not at all surprised to hear that a sharp pressure has been brought to bear upon the Centennial Commissioners, and that they have augmented very considerably the number of awards in the section of the Fine Arts.

There are two principles—one to give medals only to high and unquestionable excellence; the other, to give them to average merit. By the first, the medals become an honourable distinction; by the second, it is not a great honour to receive one, but it is a stigma to be left out. Both these principles were fully and fairly discussed in committee, and it was decided by a majority—a large one I believe, speaking only from memory,—to adopt the first. It was felt that the amount of average merit in the pictures exhibited was very great, and that if the judges lowered the standard beyond a certain point the medals must be distributed broadcast, and the honour of gaining a medal would be *nil*.

The principle adopted by the resolution of the committee was adhered to in the award of the medals, although the actual number given slightly exceeded that which had at first been approximately suggested.

Towards the conclusion of our labours it was evident that the principle of upholding a high standard had operated to the disadvantage both of nations and of individuals, and that national pride as well as private friendship was offended. You mention the case of Belgium; but it is notorious that the names of many of the most excellent painters of that distinguished school are absent. The fault therefore was that Belgium had not contributed more worthily.

The partiality of private friendship for individual painters was also offended. This, of course, was inevitable. My own opinion is, that (although I thought England was hardly treated, and expressed this view in committee) with very few exceptions the best pictures had been selected, and very few left out.

At the same time, it should be mentioned that, in order to avoid any accidental injustice, opportunity was afterwards given to each member to re-propose names already rejected. Of course, an adverse decision by the committee did not change the opinion of the proposer; the decision of a majority was bowed to, though not acquiesced in; but I repeat that these cases were comparatively very few, and by no means justify such a great extension as that now sanctioned.

I cannot, therefore, but regret that the principle of selection adopted by the committee has not been adhered to, though I have no doubt that the course now acted upon will be more popular.

Please to thank General Walker for his kind and courteous considerations for myself as chairman, and tell him that I have little doubt his action will contribute to the satisfaction of many of the exhibitors, and prevent many jealousies and heartburnings, even if it lowers the honour of gaining medals.

You know my private opinion about medals, which is also that of most Englishmen,—*they are a mistake in works of fine art.* England gives none, wishes for none; and I think it will be found that the best painters in all countries will more and more abstain from contribution to International Exhibitions; they will not submit their well-earned fame to be imperilled by the exhibition of perhaps unimportant specimens. (As a possible symptom of this tendency, I may remark on the conspicuous absence of the best painters of the French school from the present Exhibition.)

I extremely regret, as you are aware, that I had not the power of withdrawing most, if not all the English pictures from competition; and I ascertain since my return home that some of the contributors, whom I happen to have met, had entirely forgotten the question of medals, and that they had borrowed pictures to send to Philadelphia simply from a desire to respond to the invitation of the British Government, and with a generous wish that England should be worthily represented.

One good result, in my opinion, may follow from the action of the Centennial Commission in setting aside the decision of the committee in favour of a wider distribution, whereby mediocrity will be gratified and the honour of gaining medals reduced. When medals are no longer valued, it is to be hoped that their administration will cease, and that the time will come when men will exhibit "all for love, and nothing for reward."

Believe me, &c.
C. W. Cope.

No. 3.

Correspondence.

THE CENTENNIAL PAINTING AWARDS.

"To the Editor of the 'Nation.'

"Sir,—I desire to make public the facts with regard to the awards which have been given to paintings by the Executive Committee of the Commission of the Centennial Exposition. A statement of this kind seems necessary because of inaccurate stories which have been told, and in justice to the judges of the Painting Committee, and especially to the foreign judges, who returned to their native countries with the confident belief that their report would be respected by the Exposition Commission. *The larger part of the awards in painting reported by the Exposition authorities were not recommended by the regular committee.*

"The history of this business is as follows:—In Group 27 there were some twenty-eight classes of objects. The judges selected to recommend awards to these classes numbered twenty gentlemen, a large proportion of whom

were foreigners. When the group came together and was organized the work of recommending awards was assigned to committees; there were nine judges chosen for painting, six for sculpture, three for photography, and so on. All of these were selected because of their special fitness for the tasks imposed. The nine judges who formed the Committee on Painting were a body of experts of high character and rare capacity for the delicate and arduous labours which belonged to that class. These judges were Messrs. Charles West Cope, R.A., of England; Carl Schlesinger, Germany; J. Emile Saintin, France; Count of Donadio, Spain; Frank Hill Smith, F. Wier, and Geo. Ward Nichols, United States; Guglielmo de Sanctis, Italy; Kruseman van Elten, who acted in place of F. E. Heemskirck von Beest, Netherlands. At the first meetings of the judges in Group 27 an attempt was made to fix the number of awards in the class of painting; another subject of great importance was fully discussed, and it was unanimously agreed that the plan for making awards as proposed by the Commission could not altogether be put in practice in painting and sculpture. This plan was that one judge should write a full opinion of the picture or statue, and that a majority of the other judges should sign their approval. It was found that no two of the judges could agree in all respects in a criticism of a work of art, while it was not difficult to agree as to its general artistic character. Thus, a plan was adopted which divided the pictures into the following classification:—

Religious, historical, &c.;
Genre;
Landscape;
Portrait;
Animal and still life.

"In their recommendation for awards the only words used were: 'For artistic excellence' in 'Historical,' 'Genre,' or whatever class to which the painting belonged. At the beginning of the sessions of this committee information was asked of the chief of the bureau 'if the question of nationality was to be considered in recommending awards.' The answer came that the merit of the work was to be the only consideration. In obedience to this rule, governed by this principle, for every day for nearly four weeks the judges were at work, sometimes holding two sessions each day, all the while examining, making notes, discussing, and deciding. These decisions were singularly free from national or personal bias. It was intended that, while the awards might be few in number compared with other Expositions, they should be valued because they were deserved. In each case the award was made by a vote of the majority of the committee. On several occasions it was said 'We have 'given enough awards. If we pass beyond such and such a degree of merit, 'all distinctions will be lost and the awards will have as little value as those 'given at Vienna or Paris.' Finally, by an almost unanimous vote, they did halt, and, although the effort was subsequently made by one or two members of the committee to re-open the lists, it was refused, and the committee made its final report to the entire group. This report was accepted, and the awards were signed by the individual judges and endorsed by the signatures of a majority—eleven—of the other judges of the group. Subsequently the other committees made their reports, which were also accepted. The group, having finished its work, asked the Commission to be discharged. They were told that they could have leave of absence, but that a final discharge could not be granted at that time. The group then made its final report, adjourned, and all its books and papers were formally placed in the office of the Chief of the Bureau of Awards.

"With the exception of two or three, whose duties as Commissioners kept them at Philadelphia, the judges separated and went to their homes—in Italy, France, England, or elsewhere. Several weeks after this the chief of the bureau, on behalf of the chairman of Group 27, issued a call to such of the judges as were in this country to meet at Philadelphia. The object of this call was to have more awards given to paintings. There was not, at that time, in the United States a quorum of the group, and several of the judges who were here refused to attend, recognizing only the authority of the Commission to re-assemble them. At the meeting held in response to this call there were eight persons present. A committee from this body

was informed by General Goshorn that 'further recommendations for awards in painting would be considered.' Whereupon a committee of three was appointed—not one of which had served on the regular painting committee—to make out a new list of awards in painting. Two of this committee were from the United States, one from the Netherlands, and two of them did not report presence until the very last meeting of the group. The only other two members of the regular painting committee present at the meeting refused to serve in this extraordinary scheme, and protested formally against it. In the case of the German judge this action was more significant, as he was one of the minority who had in his committee favoured giving more awards. The committee appointed at the above-named meeting reported to the Commission some 128 names in addition to the 85 which had been regularly acted upon. The Commission confirmed the entire 128. The following is a list of the awards recommended by the regular painting committee :—

"France.—Daubigny (fils), George Becker, Harpignies, Schenck, P. C. Comte, Castiglione, Perrault, Carolus, Duran, Yon, Pabst, Damaron, Zuber, Commerre, E. Sain, Luminais, Prion.

"Germany.—Hiddemann, C. Lasch, Steffeck, Poschinger, A. Achenbach, Wagner, Serbel, Hertzel, Meissner, G. Richter.

"United States.—F. Hill, Miss A. Lea, Shade, W. M. Hunt, Toby, Rosenthal, Key, Bridgman, Jervis McEntee, Eastman Johnson, James Hart, W. Whittredge, M. F. De Haas.

"England.—Clarke, Stone, Perugini, Cole, F. Holl, Alma Tadema, Heywood Hardy, J. M. Jopling, Fildes, Leighton, Geo. Boughton, T. Faed, Francis Grant, Graham, Colin Hunter.

"Austria.—Kuntz, L. Parmentier, Probst, Von Anjeli, Hans Makart, Felix Graboski.

"Netherlands.—Mauve, Van Frigt, Nakken, M. Vos, Bischop, Hermann, F. C. Ten Kate.

"Spain.—Lorenzo Valles, Carlos de Haäs, Agrassot, Vera, Mercade, Antonio Gisbert.

"Belgium.—De Keyser, Van Luppen.

"Italy.—Marchesi, Maccari, Camaran, Roberto Fontana.

"Sweden.—Wahlberg, Von Rosen.

"Norway.—Gude, Sinding, Grimelund.

"The following table will show the distribution of awards relative to the different nations by the regular committee, which consisted of experts from all the great nations, and also the same distribution, so far as known to me, by the other committee, who were citizens of only two of these nations :—

	First Award.	Supplementary.	Total.
United States	13	28	41
France	17	19	36
England	14	10	24
Belgium	2	13	15
Netherlands	7	24	31
Spain	6	2	8
Germany	10	12	22
Austria	6	7	13
Italy	4	0	4
Sweden	2	0	2
Russia	4	3	7
Norway	3	0	3
Mexico	0	2	2
Brazil	0	1	1

"Cincinnati, October 1876. G. W. N."

MR. PETER GRAHAM.

INDUSTRIAL AND ARCHITECTURAL DESIGNS, MODELS, AND DECORATIONS, DECORATION WITH KERAMIC AND VITREOUS MATERIALS, MOSAIC AND INLAID WORK.

REPORT on INDUSTRIAL and ARCHITECTURAL DESIGNS, MODELS, and DECORATIONS, DECORATION with KERAMIC and VITREOUS MATERIALS, MOSAIC and INLAID WORK, shown at the CENTENNIAL EXHIBITION, PHILADELPHIA, 1876. By PETER GRAHAM, Esq., a Vice-President of the SOCIETY of ARTS.

20, Lancaster Gate,
23rd November 1876.

SIR,

1. I HAVE the honour to inform you that I attended the preliminary meeting of the judges on the 24th May, and after hearing the addresses of Mr. Goshorn and General Hawley, retired with the other judges of "Group 27" to the room allotted to us, and after organising ourselves for work, by the appointment of a chairman and secretary, proceeded to sub-divide the group in accordance with the classification of the catalogue, and appoint judges to the respective sub-divisions. *Preliminary Meeting.*

2. The sub-division to which I was appointed comprised "Industrial and Architectural Designs, Models, and Decorations, Decoration with Keramic and Vitreous Materials, Mosaic and Inlaid Work," classed in the catalogue from No. 440 to 443, and from 450 to 454, both inclusive. *Sub-division, Classes 440–443, 450–454.*

3. My colleagues were Donald G. Mitchell, Esq., of Rushaven, and Professor V. Dahlerup from Denmark. In Class 441, "Architectural Designs, &c.," we were assisted by Richard Hunt, Esq., of New York; in Class 450, "Mosaic and Inlaid Work in Stone," by Signor Tantardini from Italy; and in Class 453, "Stained Glass," by Mr. Soden Smith, M.A., of the South Kensington Museum, as associate judges. The total number of exhibitors in this sub-division was 265, and the number of medals recommended 103. *Colleagues in Sub-division.*

4. The completion of our work was considerably delayed in consequence of the unprepared state of the Exhibition, and it was not until the 23rd June that the last objects comprised in the group were ready for inspection. *Delay.*

5. In consequence of the decision of the Commission that the awards should consist of one description of medal only, the value of the award being graded by the reasons given for its recommendation, the task of the judges was rendered delicate and difficult. But in each case where an award was recommended, the reasons for such recommendation were appended. As it is not probable that these reasons will be generally read, the effect will be that all medals will have nearly the same commercial value, and thus exhibitors of very great merit will be apparently placed on the same level in the eyes of the public as those who were just sufficiently good to obtain the recommendation of an award. I am of opinion that much more practical and substantial justice would have been done had the Commissioners allowed medals of different value to be given for different degrees of merit, as in the case of former exhibitions. *Nature of Award.*

6. Following the classification of the catalogue, I may say that in Class 440, "Industrial Designs," there were very few exhibited, and those possessing very little merit. To only two of them did the judges recommend awards. *Industrial Designs.*

7. The "Architectural Designs," Class 441, were much more numerous, especially from the United States, many of them being very meritorious and mostly of a monumental character. Great Britain, Austria, and Spain rank next in the number of architectural works exhibited. *Architectural Designs.*

8. As regards Class 443, "Decoration of Interiors of Buildings," the examples exhibited were neither numerous nor important, but some of them were very good specimens, especially one in the style of the latter part of the eighteenth century, and several others in the Early English style, the most important being the interior of the house of the British Commission, which has been carefully studied and well and consistently executed. There were a considerable number of specimens in very showy and vulgar taste, and of inferior execution. Of the paper-hangings exhibited by American manufacturers, the best examples were, avowedly, copies of English and French designs. *Decoration of Interiors of Buildings: St. George's House.*

9. In Class 443, "Artistic Hardware and Trimmings, Artistic Castings, Forged Metal-work for Decoration, &c.," the specimens exhibited by manufacturers of the United States were numerous, and many of them in very *Artistic Hardware, &c.*

good taste, showing great progress in that branch, especially in the production of articles employed for the interiors of buildings. The exhibition of stoves was especially worthy of commendation. The largest and most important exhibition of decorative metal-work was from Great Britain, many of the objects being in very pure taste and of perfect execution. The prevailing style of nearly all was Mediæval or Early English, and of an ecclesiastical character. Among other objects there was an important exhibition of stoves, in very good taste, of first-rate execution, and artistic character.

Mosaic and Inlaid Work in Stone.

10. Class 450, "Mosaic and Inlaid Work in Stone." In this branch of Industrial Art, peculiar to Italy, there was an exhibition of great variety and merit, comprising copies of celebrated pictures (two from the Vatican) admirably executed, original designs representing foliage and flowers (wonderfully perfect imitations), objects in perspective and figure subjects, all showing more or less merit in design and execution, and some of them a high degree of excellence. A table from Sweden was specially noteworthy, and a malachite chimney-piece from Russia, inlaid with choice specimens of various marbles, forming geometrical designs, also called for very favourable notice.

Mosaic and Inlaid Work in Tiles, &c.

11. In Class 451, "Mosaic and Inlaid Work in Tiles, Tesseræ, Glass, &c.," there were few exhibitors, and none of the objects classed in Group 27 were deemed worthy of a recommendation for a medal.

Mosaic and Inlaid Work in Wood and Metal, &c.

12. Class 452, "Inlaid Work in Wood and Metal, Parquetrie Inlaid Floors, Tables, &c." Of the inlaid work in wood (apart from furniture not included in Group 27), the largest number of objects was from Japan, and the arrangement of the various woods, all choice specimens of their respective kinds, formed ingenious and beautiful designs in harmonious contrast, showing great skill in workmanship, characteristic style, and excellent taste. The parquetrie exhibited was of the usual character and chiefly European, the finest specimen shown being from Belgium. The table-tops and other objects in inlaid woods were not worthy of any special notice.

Inlaid Metal-work.

In the exhibition of inlaid metal-work also, the Japanese had several works of great beauty of form, and of the highest degree of excellence in execution, the inlay being of pure gold, silver, and pure copper upon bronze. They appear to have great skill in the mixture of metals, by which the tone of colour of the groundwork is made to show various inlays with the best effect. The objects from Great Britain (few in number) may be described as perfect in design and execution, and the few objects from the United States in the Japanese style were of perfect workmanship. From Spain also there was a number of objects, many of them displaying a high degree of excellence both in design and workmanship. The ornamental metal-work, mediæval and modern, from the government manufactories, included many beautiful and interesting objects.

Stained Glass.

13. Class 453, "Stained Glass." There was a considerable number of exhibitors in this class, and nearly all the specimens had more or less merit. The progress in this branch of Industrial Art may be considered generally satisfactory, and some good novel effects were shown.

Miscellaneous Objects.

14. Class 454, "Miscellaneous Objects." Under this head there is nothing that calls for any special notice.

High Tariff.

15. As might have been anticipated from the high tariff of the United States, and the expenses necessary to be incurred by exhibitors, Industrial Art from Europe was very poorly represented, and the absence of nearly all the most important French producers was very conspicuous.

Concluding Remarks.

16. If not exceeding the limits of my commission, I would venture to make a few brief remarks on the commercial policy in the United States, especially as regards some important changes that may speedily be expected. Manufactures there have been created and fostered by a system of protection, which, through the enhanced prices paid by consumers, must have been very costly to the nation, but of the result they may have reason to be proud, since it has made them to so great an extent independent of other nations for their supplies, and whatever course their legislation may take, their manufactures are likely to be further extended. The great progress made in the manufacture of cotton, wool, and hardware, the fertility of invention, which has produced so many ingenious machines for economising labour, are but an index of what may be expected in the future. Opinions are much divided, but free trade principles are gaining many supporters, the result of which will probably

be, that the import duties on all raw materials used in manufactures will be greatly reduced, or totally repealed. This will enable the manufacturers to produce much more cheaply, and will doubtless be followed by a large reduction of the existing high protective tariff, the natural consequence of which will be a large diminution in cost to the great body of consumers. The great saving thus effected will naturally leave a large sum free, to be invested in industrial undertakings, or otherwise expended, and will lead to a greater amount of prosperity on a sounder basis than the United States have ever yet enjoyed, more especially as a return to a sounder currency by the resumption of specie payments or "hard money," as they term it, may shortly be expected. A Bill to effect this object has already been passed by Congress, but no practical plan for carrying it into effect has yet been propounded by the Government. The subject, however, will doubtless receive attention on the accession of the new President. The demand for objects of European manufacture will thus be stimulated, and commercial transactions between the United States and the older countries largely increased, but the nature of the business will probably undergo a considerable change.

The current articles in large demand the United States will manufacture for their own consumption, and in these compete with us in foreign markets.

Exports from Europe will be those in the production of which design, novelty, taste, and great technical skill are necessary and important elements. For these, there will doubtless be a large and increasing demand, measured by increasing wealth, until America shall have established museums and schools of art, upon the principle of the South Kensington Museum, where the art of design is taught, and examples of Industrial Art of various periods are collected for study.

I have, &c.,
PETER GRAHAM.

To Colonel H. B. Sandford,
British Executive Commission,
Philadelphia.

SIR CHARLES REED, LL.D.

SECTION OF EDUCATION.

Report on the Section of Education at the Centennial Exhibition, Philadelphia, 1876, by Sir Charles Reed, F.S.A., LL.D., appointed Judge in that Department for Great Britain.

My Lords,

I have the honour of presenting to you a brief report of observations made by me in fulfilment of the duties entrusted to me.

Limits of the Exhibition.

Attention may be directed at the outset to the somewhat narrow limits of the Philadelphia Exhibition in the section of Education. Although every country was invited to exhibit, little or nothing was sent by Great Britain and her colonies (Canada excepted), by France, Germany, Norway, Austria, Italy and Brazil, save maps, school books and general publications. The absence of countries like these could not but deprive the Exhibition of its universal character, and prevent a full comparison between European and American systems of teaching. Whatever the cause, and probably it is to be found chiefly in the high protective duties of the United States, disinclining school managers and the makers of school material to incur the expense of exhibiting, the result is the more to be deplored in that, elementary education having now taken its place as a science, it was of the highest importance at the present moment to collect and examine the experience of many nations.

The countries that entered most cordially into the competition were the United States, Canada, Sweden, Belgium, the Netherlands, Switzerland, Spain, Russia, Japan, and the Argentine Republic. By these alone was any appreciable show made of specimens of school work or reports of institutions.

udges on ucation.

My colleagues in Group XXVIII comprised representatives of four countries. They were as follows:—

United States.—Hon. Andrew D. White, LL.D., President of Cornell University, Ithaca, New York; D. C. Gilman, LL.D., President of the John's Hopkins University, Baltimore; Hon. J. M. Gregory, LL.D., President of the Illinois Industrial Union; Hon. J. W. Hoyt, M.D., LL.D., Madison, (Secretary).

France.—M. Réné Fouret, Hachette et Cie, Paris; M. E. Levasseur, Member of the Institute and Professor of the College of France.

Sweden.—Professor Otto M. Torell.

Spain.—Col. Juan J. Marin, Engineer Corps, Madrid.

In addition to these MM. F. Buisson and A. Caubert were sent by the French Government with four school teachers as a commission to make enquiries and report.

It was a mark of deference and good-will towards Great Britain that, although she was practically unrepresented in this section, her delegate was chosen President of the above Board of Judges. It became his duty further to assist the British Judges in other groups in making special awards, on behalf of the Canadian Commission, to exhibitors from the Dominion.

Wide range of Group xxviii.

But the range in the department of education was sufficiently wide. We found ourselves called to decide on the merits of a vast number of "exhibits" in eleven classes, Nos. 300 to 306, including educational systems, methods, and libraries, and Nos. 310 to 313 dealing with what were succinctly called "Institutions and Organizations," though really embracing things as remote from education and one another as agricultural fairs, dentistry, and the drama. It will be my aim to present to your Lordships a report of those exhibits alone which more closely concerned popular education.

Preponderance of the United States.

Adopting this line, my report must to a large extent be an account of the position of common schools in the United States, inasmuch as all the other countries exhibiting were wholly subordinate to, and overshadowed by, the American display. It may give an idea of the completeness of the preparations

made in this department to say that every State in the Union was authorized to appoint a commission, a certain sum being voted for the purpose of enabling it to send up a collective exhibit of statistics, literature, and students' work actually done in school and shewn in bound volumes, with drawings and maps. Most of the States responded, and of these the principal ones sent each its Superintendent of Public Instruction, who remained at Philadelphia with his staff the whole time we were there, to offer explanations of novel apparatus and of the various systems pursued. There were two Kindergarten schools and a model school in daily work in the exhibition grounds; while visits to schools in the adjacent city were readily organized.

Countries slightly represented.

Before dealing, however, with the subject of American education, it will be well to dispose of the part taken in the Centennial by the other competing countries; and first of those but slightly represented.

Great Britain

Great Britain shewed at Philadelphia only nine exhibits having any direct connexion with education. Beyond a set of valuable photographs of London Board Schools, there was nothing more important than writing frames for the blind, Sunday school registers, a military model apparatus for illustrating drill movements, a few maps, and a solitary example of calligraphy, which last did not arrive. These were followed by 25 exhibits of books and engravings, and by four claiming to represent our "Institutions and Organizations," which amounted to two sets of maps from the Ordnance and Geological Surveys, some catalogues of previous exhibitions, and a number of objects from South Kensington forwarded by order of your Lordships.

and Colonies.

New South Wales contributed some interesting meteorological and other statistics, and specimens of the Natural History of Australia; while Victoria sent photographs of State schools, colonial reports, and work done by pupils of the Melbourne School for the Blind.

France.

France was represented chiefly by books; but her 84 exhibits included some excellent albums and cartoons from the industrial school, S. Quentin (Aisne), together with a few documents and reports from the Paris Elementary Education Society and the National Schools of Mines and Engineering, copy books from the firm of M. Godchaux, and manuals of geography from that of M. Delagrave.

Germany.

Germany submitted a large collective exhibit of its book trade and printing industries; the only other noticeable feature in her division, apart from the technical exhibits referred to under that head, was the fulness and excellence of the geographical work.

Norway.

Norway, though sending little, showed an interesting collection of materials for a free school, from the Bergen Common School Board.

Austria.

Austria made but a poor return to the United States for what they had sent to Vienna in 1873. A few photographs of objects pertaining to education, a specimen of artistic penmanship, and the "gymnastics of the senses," were almost all that had any bearing on education; the same exception, however, must be made as in the case of Germany in regard to technical instruction.

Italy.

Italy furnished little beyond some music, a few didactic treatises and a set of microscopic anatomical preparations; being surpassed by Brazil, which made a fair display of work done by pupils in schools of Rio, and of provincial newspapers.

Brazil.

Countries more fully represented.

Proceeding to the countries which put forth a systematic effort to shew the existing state of education among them, notice is arrested first by Sweden with its specimens of work from the Nääs School of Home Industry and the Vrana National High School, its fine collective exhibit from Technical Elementary Schools, and especially the Primary School House erected in the grounds of the Exhibition by the Royal Swedish Commission.

Sweden.

This last was a one story frame building, fitted with all the accessories of furniture, books and charts. Bright with maps and objects of natural science, well lighted and equipt with the single desks, with seats attached, devised by Mr. Sandberg, little was left to be desired; and the praise was fully confirmed which had been awarded to Sweden at Vienna. Some of the samples of pupils' writing were remarkably good, notably so that of Ida Johansson, 12 years of age, in the Maria Folkskola at Stockholm, and Augusta Andersson, 6 years of age, after 2½ months' lessons.

Belgium. Belgium showed an advance upon the position she took up at the Austrian Exhibition. Since then a new law has been enacted for schools, books, apparatus and ventilation, the result in main part of the report of delegates sent to Vienna, whose conclusions and recommendations were adopted by their Government. Among the most noteworthy exhibits were types of school furniture approved by the Belgian Government, sent by the Education Department; examples of the writing method approved by the State, a collection of school books, and some "adjustable" desks.

The Netherlands. The Netherlands did not furnish adequate or worthy illustrations of their highly developed system of school boards and official inspection. Their display consisted principally of drawings and designs from the Rotterdam School of Art, and the Amsterdam Workmen's Artisans' School, reports from Blind Institutes and Institutes for the Deaf and Dumb, writing apparatus for the weaksighted, and even "plaster casts of cattle that died of murrain in 1865," thus, as in England, connecting schools and cattle plague.

Switzerland. Switzerland made a particularly good exhibition. A careful selection of reports from the Boards of Education in nine cantons revealed the thorough organization of the Federal Schools; while a large number of "obligatory and facultative" text books and apparatus used in elementary and higher schools showed the admirable provision made for the young as clearly as the pupils' work showed the good use made of that provision. The statistical part of the Swiss section was unsurpassed, save perhaps by the state of Ohio, and afforded a noble monument to the free institutions of the mountain-republic. Memoirs were furnished by several of the Historical and Statistical Societies; and copious details were supplied of the operations of the Mutual Relief Societies, the Asylums and Cantonal Societies for promoting the public welfare, which afforded good proof of the blessing which education and intelligence have brought to the country.

Spain. Spain, though behindhand in education, gave the impression of a land anxious to advance and struggling towards the light. Out of 600 exhibits shown in the special Spanish building, two-thirds belonged to our department. The greater number were books; but there were also desks, text books, specimens of pupils' work, and objects for the instruction of children. The Institutes for the Deaf and Dumb and for the Blind at Madrid and Seville sent reports explaining their methods, and several Boards of Primary Instruction and local Institutes exhibited treatises and documents.

Russia. The Russian exhibits gave evidence of careful instruction in schools, especially in the sciences related to mechanical engineering. From the Practical Technological Institute at St. Petersburg came a systematic collection for instruction in working metal; from the Strogonoff Central School of Technical Drawing at Moscow samples of work done by the pupils; and from the Imperial Technical School, also at Moscow, a collection of furniture and models for technical instruction, and specimens of pupils' work. The ethnographical models from the Female Workshop of Educational Appliances were admirable; and commendation is due to some collections of minerals and botanical specimens sent from the Pedagogical Museum, to apparatus for mechanical drawing in schools, and to an ingenious rule for measuring curves.

Japan. Japan has for several years displayed a remarkable anxiety to procure the best school models. To this end visitors have been sent to inspect our English schools, and many Japanese teachers are being trained abroad at the expense of their Government. Upon the reorganization of public instruction which followed the Revolution of 1868, the Emperor established primary and higher schools, and selected youths who might be sent to finish their studies in Europe and America, and observe western systems of education. In 1872 an enlightened code was promulgated, and the budget of public instruction fixed at 400,000*l.** The regulations now in force bear date November 1875; according to them, wherever local authorities fail to provide school accommodation, the Government orders a school tax to be levied, lightening the burden in cases where the inhabitants are poor. Free education is recognized only for children unable to pay fees. Inspectors are appointed, and frequent reports sent in. The Government causes to be published elementary school books

---

* Dr. Charles Saffray, in a series of articles contributed to the *Manuel Général de l'Instruction Primaire*, Paris.

and treatises on teaching, based on the best experience of more civilized countries; nay, it even issues to the teachers papers on education containing articles translated from foreign journals. Though the system of mixed schools has not been adopted, girls are treated as on an equality with boys and entitled to the same care; the Empress recently showed her interest in female education by going in person to open the first normal school for girls at Tokio.

The Japanese building was rich in books of elementary science, maps and plans of schools, chairs and tables, almanacs, histories and newspapers, but the pictures illustrated as well as anything the present system of instruction. In contrast with the old schools, where master and pupils assumed the most indolent attitudes, we see classes in large and airy rooms, each pupil with a slate before him on which is reproduced the lesson of the day. Teaching by the eye is a strong point with the Japanese; the scenes of rural and domestic life are portrayed with a vividness that draws from Dr. Saffray the exclamation: "In all this there is nothing pedantic or artificial; these are scenes taken from "life, in which one may discover the touch of humour, whereby the attention "of children is so surely obtained. Who will execute for our schools "a series of joyous designs like these which are put before the eyes of the "little Japanese?" The mechanical powers are illustrated in the same graphic way, and moral lessons are conveyed far more effectively than by mere oral teaching, Here is a horse tied to a tree; while its master is away, one child tickles it with a switch, while another pulls hairs out of its tail. Here is a blind man on the point of being knocked down by a vehicle, when a child runs up to him and leads him to a place of safety. With regard to the school material shewn by Japan, it may be enough to say that the desks were of a size to accommodate two or three pupils, constructed on the London model, with seats independent, and fitted with backs.

he Argentine epublic.

The Argentine Republic made a creditable appearance, exhibitors from the Provinces of Buenos Ayres, Entre Rios, Santa Fé, and Tucumen sending statistics and memoirs of their schools and libraries, while other provinces were represented by maps and legal or educational works.

Canada.

Canada would not have been conspicuous but for the excellent show made by the Education Department for the Province of Ontario, to which, in the Special Canadian Competition, a Gold Medal was awarded by the British judges. While the country schools are as a rule poor, the upper and primary schools in the cities, as in Toronto and Hamilton, are as advanced as in the United States, and the methods in some cases superior. From an able paper prepared by the Hon. Adam Crook, LL.D., Minister of Education, it appears that Ontario had in 1874 as many as 4,758 schools open, with 5,736 teachers, and 192,898 children in average daily attendance, though 443,099 were "at school," out of a school population of 511,603. The sum raised in the same year for the support of these schools was 647,000*l*. The high schools were 108 in number, with 7,871 pupils, and an expenditure of 57,000*l*., while two normal schools were established, one at Toronto and the other at Ottawa.

Technical Education.

These general observations would be incomplete without some reference to the increasingly important subject of technical education in its most practical form. The Industrial Schools of America are formed on the Continental rather than the English model. Following the example of Hamburg, the Americans are now busy establishing such institutions, with school-shops in which boys and girls are taught various trades. The exhibits in this special department were inspected and reported upon with great care by the State Superintendents. The most important examples may here be noted with a view to promote a similar display on the part of England at the forthcoming Paris Exhibition.

The Schools of Building in Leipzig, Dresden, &c. are designed to prepare the pupils for mechanical, chemical and manufacturing industries. Würtemberg reports 50 such schools, Bavaria 150, eight being models devoted to special industries, such as building, machine-making, cabinet-making, or sculpture. The Polytechnic Association of the circle of Würzburg has lately established 111 schools for apprentices, employing no fewer than 315 professors, whose teaching has special reference to design, hygiene, and political economy. Though Austria followed Germany at a distance of eight years she has fairly outstript her teacher; her *Realschulen* for the burgher class at Vienna, Reichenberg and

Brünn are supplemented now by 20 "complementary schools" for giving instruction to the poor in the designing and manufacture of lace. In the capital and provinces six establishments have grown up since 1870 for cabinet-makers, masons and watchmakers, in addition to 16 schools for working in wood, ivory and marble, besides others for toys, and seven for small arms—a graver kind of toy. Thus the rural dwellers in Bohemia, Silesia and Moravia have acquired a knowledge of new trades; and the very shepherds and cowherds of the Black Forest are busied in carving for the markets of the Austrian Alps. The work of the Imst school is well known, and the figures from Innsbrück, St. Ulrich and Wallern are admirably executed. Bohemia, in addition to the above, possesses many glass schools at Steinschoenen and other places. The exhibits from the Artisans' school at Rotterdam, and the great technical schools at Stockholm, Lisbon, Moscow, and St. Petersburg, were by far the most systematic and instructive, calling forth from one of America's far-sighted sons the exclamation: "The United States must be blind indeed not to profit by the lesson taught her here." The technical school at Moscow has 600 pupils, and the course covers six years, spent in practical study in the workshops.

It only needs further to allude to the Pedagogical Museums of Industry and Art which are reported as abounding on the Continent of Europe. South Kensington has indeed furnished an admirable model; but England should not be contented with one South Kensington. Exhibitions of the means of instruction and "depositories of education" should be as familiar to our people as they are at Zürich, at Vienna, at Toronto and St. Petersburg, from which full and interesting contributions were sent to Philadelphia.

The United States.

The ground having been cleared by this sketch of the part taken in the Centennial by America's visitors, it remains to give some idea of her own position as shown in the section of education.

Public school fund.

The territorial area of the Union is 3,250,000 square miles, of which 2,265,625 are public land. One sixteenth of this public land in the several townships is set apart for educational purposes, and called the School Lot, or Sixteenth Section. This land has in most cases been sold, and the proceeds invested for school purposes, giving, with endowments, an annual sum of $5,175,166. Adding $58,855,507, arising from state and local taxation, we have the entire school income, irrespective of special funds, like that established by Mr. George Peabody, and now amounting to $2,000,000.

No school fees.

No part of the school income is derived from children's fees. It is enough here to say that the free system is not unchallenged. Many of the best teachers affirm that the parents who pay nothing care nothing; and that to this cause must be ascribed much of the indifference which so largely prevails among parents in the States.

Taxation for education cheerfully borne.

The amount raised by taxation presses heavily in many districts, yet it is borne without a murmur. The question seems to be, not how much per head, 4*l.* or 4*l.* 4*s.*—but, what is the best result? The last Report of the School Committee of Massachusetts, says:—"The poorer we are and the " more behindhand in what concerns education, the more ought we to spend " money to rise at least to an honourable rank. In discharging the school " tax, property pays for its own protection. It is by education alone that the " law can reach the dangerous elements of the population." These words recall the noble utterance of Horace Greeley, that "man's work is productive " in the proportion in which his intellect is cultivated. The labour of an " ignorant man has scarcely more of value than that of an animal of equal " strength. There is not a farm, a bank, a manufactory, a shop—except the " public house—whose earnings are not greater if it be situated in a locality " where the population is instructed and moral. It is then self-interest which " bids the owners of property contribute to spread instruction amongst all " ranks of society."

New England and Northern States most advanced.

It is but natural that the New England schools should lead the way, from the antiquity of their organization; all have made great progress within the past ten years, New Jersey being the sole exception. So far as could be judged by the Exhibition, Massachusetts, Ohio, Michigan, Indiana and Pennsylvania, were the most distinguished, Michigan presenting perhaps the best system; while no single city was superior to Cleveland, closely followed (in alphabetical order) by Boston, Chicago, Cincinnati, Manchester

in New Hampshire, New Haven (Conn.), and St. Louis. The excellence was not of the same kind in each case. Thus, Ohio excelled in statistical diagrams, school exercises, drawing, and the designing of lace patterns; New Hampshire and Chicago in English orthography, the result of writing under dictation, and careful correction by the pupils. The State of Pennsylvania making, as a whole, so excellent a show in the special building placed under the admirable care of its superintendent, Mr. J. P. Wickersham, it was not strange that Philadelphia should be less prominent, the more so as the city schools were supposed to be open to the inspection of visitors to the Exhibition. In places like Cincinnati good schools seem to be promoted by the presence of the German population, which insists on education. It were well, indeed, if it could be said of our English towns, as Mr. Philbrick reported of Boston, that "in ten years he had not met with a single child who had "resided in it to the age of 14, without learning to read and write."

Southern States behindhand.

In theory all schools are built after the New England model; but the Southern States, notwithstanding vigorous efforts to advance, compare disadvantageously with the rest of the Union. Thus, in Tennessee, the teaching must be somewhat elementary, as the cost is only $3½ a year, per child. In Mississippi, owing to the teachers being paid in warrants, whose value ranged from nothing up to 50 cents in the dollar, many schools were closed and others kept open only for a small portion of the year. In Louisiana only one-fifth of the children was even enrolled in 1873, and the authorized report confessed that official mismanagement had destroyed public confidence in the common school system. For want of suitable buildings, scholars were being taught out of doors under trees, or in rooms that had neither doors, windows nor flooring. In Texas the system is said to be "struggling with every conceivable difficulty." In Alabama in 1873, out of $500,000 apportioned for education only $68,000 could be obtained from the state treasury, and this only in teachers' warrants, the result being "an almost entire paralysis" of primary education, In Florida three teachers out of every four are reported as unfit for their work, nor is there a single high or normal school, teachers' institute or college, to make them better. Grenville County, in South Carolina, received only $800 out of the $12,000 which came into the hands of the county treasurer, a man who, "being pardoned from serving a term in "the state penitentiary, afterward received possession of the school funds from "the state treasurer, and immediately left the State."*

Lack of central authority.

Thus it will be seen that it is not accurate to speak of the United States as though they contained no ignorant class. The common school system is universal rather than national. The independent action of the states needs to be connected, and the reins of authority drawn up into the hands of some central board of control. The Bishop of Manchester, Dr. Fraser, says that local self-government is the underlying principle of democratic institutions, and so is the main spring of the American common school system." In the absence of any federal education law embracing all the states, each state adopts its own regulations. The member who in 1867 introduced the bill to establish a central bureau at Washington, said, "Our Government does "not allow us to establish a compulsory system of education as is done "in some countries of Europe. There are states in this Union which have "adopted a compulsory system, and perhaps that is well. It is for each state "to determine." As a matter of fact, every Northern and Western State, except Maryland, has adopted a compulsory law of school provision. Each has its own Board of Education to which it is left to provide the funds and organize the schools; but the bureau at Washington has no power beyond that of collecting and tabulating statistics. One disadvantage of this is that there is no uniform standard of teaching or inspection or examination throughout the Union; while a yet graver defect is that sufficient check is not exercised over the more ignorant districts. Mr. Wickersham impresses as the first lesson of the Exhibition, "that the policy of placing so much power in the hands of local "school boards, as is done by our laws, has its weak as well as its strong points. "Among intelligent citizens, alive to the interests of education, it is worthy of "all praise; but where an ignorant people, or a people wanting in public spirit, "elect school boards like themselves, no policy could possibly be worse."

Compulsory school provision.

* *Atlantic Monthly*, July 1876, p. 128.

As to the distinct question of attendance at school, direct compulsion is not known in more than nine of the states, and there only recently, and with results not wholly satisfactory. The National Teachers' Association is found to be urgently demanding it in several important states where indirect measures have proved a failure. One authority rebukes his countrymen in these terms: "Go up and down our cities, and how few can even seat, and how many "less can educate the total number of school age! Not a single state can do "it. Until this reproach is wiped out, how can any American boast that his "country has the means of being an educated nation?" The average attendance in eight of the principal cities of the Union is as follows:—

Compulsory school attendance.

In Boston	83·2	on the children enrolled.
„ Chicago	61·2	„ „
„ Cincinnati	76·9	„ „
„ Cleveland	64·1	„ „
„ New York	54·4	(including evening schools).
„ Philadelphia	86·4	„ „
„ St. Louis	67·6	„ „
„ Washington	71·8*	„ „

The first-named of these employs one "truant officer" to about 22,000 inhabitants; whereas in English cities there is one "visitor" to 16,000; but these latter officers undertake far larger duties in regard to absentees.

There is a general impression that in the States all classes meet in the common school. This must be modified, as the introduction of certain classes in large towns has caused reluctance on the part of many parents to send their children to the common schools. But in many towns private seminaries are springing up, a fact which destroys the old boast of social equality, although in the country districts it may still be said with truth that rich and poor meet together.

Separation of classes in school.

The Coloured Schools promise good results. At Washington the Jefferson and Sumner Schools are fine examples; here may be seen the most refined teachers, themselves persons of colour, an evidence of the determination that prevails in their race to rise in the social scale by the force of education. The successes won at Yale and Harvard by young men of colour, who prefer the name of negro, attest alike their abilities and spirit. The operation of the Freedman's Bureau in connexion with the George Peabody fund, has been of incalculable service in the south, so that the only wonder, as one writer puts it, is that some other millionaire has not doubled it. The Superintendent of Virginia says:—"It may safely be asserted in regard to the majority of our 155 graded "schools, that they could not have come into being without aid from this "source." There is a statute which provides that a coloured school may be demanded in any district where at least 20 pupils can be found for it within "a reasonable distance." Many white parents have taken advantage of this elastic phrase, to compel the establishment of separate negro schools where there was practically no need for them, and where, in order to rid their own children of "offensive companions," the latter were obliged to walk five or six miles each day to school.

Separation of races. Coloured schools.

The importance of this subject of coloured education may justify me in giving one or two illustrations of the ideas now working in the minds of children born in slavery. They are transcribed literally from short themes on the advantages of education:—

E. A., aged 15, Norfolk, Va. "Education is a good thing to have if we use it right. We are not got it yet ans we don't know the use of it. When we go to school long enough we will have it if we strive hard "for it."

J. A. "Education will make you a fine man; it will make you know "how to behaive perlightly, and have neat actions, and to work mechanically, "and to travel through part of the world. It will make you know how to do "right. I hope that I shall learn more, if I have the opertunity, and I will "make myself an educated man."

F. C., aged 16, London, Va. "Education will keep people from cheating "you, if you do not have it people would fool and cheat you out of all your "labour after you work for it."

---

* Adam's *Free Schools in the United States*, p. 111.

W. B., aged 16, Tanner Creek School, Va. "Education gives you power "and prepares you for good society if you wish. All of the men that have "ever become to be great always had an education or part of it. It opens your "ideas, and makes you interested in things."

T. H., aged 9, born free. Norfolk, Va. "Education teaches us how to be "good, wise, and useful in the present world, and how to love and serve the "Lord, and behold his works, sun, moon, and stars, and all. If I was to "sit down and think I could not tell the whole good of it."

Separation of sexes. Mixed schools.

It is a result of the prejudices of colour that mixed schools are found only north of Washington. South of that city the sexes are taught separately.

Absence of infants.

As is well known, the inferior limit of school age in the United States is six years, so that the infant department, as we understand it in this country, is unknown. It is singular that even where other parts of the European school system are spoken of with praise, this is passed by without an indication of desire to borrow it. Many object that the cost would be too great, and that parents should provide for their infant children at home; an argument which they are careful not to push too far. The result is, that a great loss is sustained, through influences of the most valuable kind not being brought to bear during the earliest years of childhood.

Kindergarten system.

Hope, however, comes from the direction of the Kindergarten system, to which increasing attention is now being drawn in America. Many schools on the Froebel model have been established in large cities, especially in New York, Boston and Philadelphia, and teachers are asking to be trained in the method. Its spread is likely to be promoted by the two schools set up at the Centennial, the instruction in which was witnessed by multitudes of visitors from various states.

Teaching as a profession.

Teaching in the United States is not recognized fully enough as a distinct profession. It is regarded too much as a stepping-stone to some better and more settled position in life. There are more reasons than one for this state of things. The appointment of teachers depends in too many cases not upon the fitness of the candidates but upon personal or political reasons. One superintendent says in regard to favouritism, "Teachers are hired first and "examined afterwards, and woe to that man who refuses a certificate to a "friend of some member of the district committee." But it appears that the superintendents are themselves in some cases in fault; they have absolute control over the teachers and are by no means always free from political bias; so that many well qualified persons refuse to become teachers when employment must be purchased at the sacrifice of independence. "The first reform," says Dr. Saffray, "which the friends of education should desire to see realized, "is the abandonment of a system which hands over the nomination of teachers "to men whose authority lasts only three years, and who are influenced, in "spite of themselves, by the very circumstances to which they owe their own "position. The teacher ought to be chosen by merit ascertained by certificates "and serious examinations; he should be assured of his post as long as he "remains worthy of it; his salary should secure to him a moderate degree of "comfort, and after 25 years' faithful service, he should be able to count for "the rest of his days upon support against distress."

Appointments otherwise than by merit.

Low salaries.

The low salaries given to all except the first rank of masters operate as a hindrance to the teaching profession establishing itself as it ought to do. Female teachers receive salaries so small, especially in the rural districts, that it is no wonder they should be easily induced to better themselves by marriage; and marriage is almost universally a disqualification for further service. As it is, they preponderate largely throughout the States. In Amherst, New Hampshire, the 17 teachers of one school are all females, and even "in Massachusetts out of 9,216 teachers 8,047 are women receiving an average salary of 68*l*." and employed of course for economy sake. It is somewhat strange that in Germany where the sexes are taught separately all the teachers are men, even in the girls' classes, whereas in the mixed schools of New England almost all the teachers are women. And the same holds elsewhere; in St. Louis, for example, the 81 schools have 654 teachers of whom only 60 are men. It cannot be doubted that female teachers give a decided tone to the manners of the children, and secure an amount of deference rarely given to men. But this is no compensation for the disadvantages of the system, and Louisiana has passed a law by which women are to receive the same payment as men, in the hope that the practice may thus be checked of bidding for cheap teachers.

Preponderance of female teachers.

Against this defect must be set the decided advantage which American schools enjoy in being free from the difficulties that arise in the employment of pupil teachers. The schools are everywhere supplied with a full complement of adult teachers. If the latter were always well trained, our congratulations would be unreserved; but unfortunately complaints are heard on many sides, that the level of attainments is low. Thus Mr. Philbrick speaks of the "almost "universal evil in American schools of substituting the setting of tasks and "the hearing of lessons for real teaching"; and Mr. Wickersham writes, "we "want less of words and more of things; less of abstract rules and definitions "and more of living facts."

Absence of pupil teachers.

It may be said of the school period that the great drawback is the tendency to abridge it unduly. Differing in every State, it ranges from 13 weeks to 5 months. To meet this, teachers are often engaged by the month, and thus never feel themselves a part of the permanent school staff, but have to seek other occupations; and the incentive to high qualification is greatly checked. Canada, on the contrary, insists upon a longer period, the average of which may be taken at eight or nine months.

The school period.

Abundant materials were furnished us, for arriving at conclusions in regard to the American common school system, in the reports which each State is bound to publish annually, and in which a vast array of facts is assembled. What was even better was the exhibition of school material, and the three model schools to be seen in actual work.

Completeness of Exhibition by the States.

A single example will serve to show the wonderful completeness of preparations made by some of the States for the Exhibition. The prominent educational exhibits from the Commonwealth of Massachusetts alone occupied eight rooms in the north and south wings of the main building. In the *first* were drawings from primary grammar and high schools, photographs of school premises and specimens of Kindergarten work, slate work from primary schools, philosophical apparatus furnished to each of the 50 grammar schools, and examples of sewing for the same in six portfolios. The *second* room contained a large collection of drawings from free industrial evening classes, a complete set of Reports of the State Board of Education from its origin in 1837 in 26 volumes, an entire set of the school reports of 341 towns and cities in the State, and a copy of every newspaper and periodical published in it at the present time, 354 in all. In the *third* room were drawings from the Normal Art School, and 50 portfolios from similar schools in 19 towns; while room No. *four* gave examples of Mr. Walter Smith's system of drawing adopted by the State Board of Education. The *fifth* enabled one to trace the results of work done in the Institute of Technology, with numerous specimens of students' work, including published memoirs, inventions, and theses of graduates. *Next* to this came photographs of all the higher schools of the State together with books and reports, four counters being covered with scholars' exercises in 218 bound volumes. The *seventh* room contained an elaborate exhibit from New Bedford of the system of instruction in towns of the second rank of population; the Worcester Free Institute sending its time-chart of subjects, its chart of "absence and tardiness," and 22 volumes of theses and examination papers done by the classes of 1876. The *last* room was devoted to astronomical drawings, illustrations of "visible speech," a chart frame of maps relating to the social and physical condition of the State, a map showing the extent of American missions, and plans of prisons, hospitals and State asylums for the insane.

***e.g.* by Massachusetts.**

Deferring to a later paragraph any remarks on school buildings, a few points may here be touched upon in connexion with the primary schools of America.

(1.) Primary schools.

The good order and discipline is a feature that strikes every visitor. It begins with the methodical arrangement of hats and cloaks and lunch-boxes in the entrance lobby, and is carried throughout the school-hours to the quiet dispersion of the children.

Discipline.

The range of studies is by no means wider than is found in our own elementary schools. The Americans feel keenly the difficulty placed in the way of English-speaking children in learning to read, and a Commission has been appointed to consider the advisability of an amended orthography, while

Subjects taught: Reading.

a Conference was held in the summer at the Centennial on the same subject. The movement contemplates reasonable reform rather than violent change, and does not propose to destroy that invaluable clue to the meaning and history of words which etymology supplies. Already "Leigh's Method" is being extensively used as an experiment in the district around Boston. By its means beginners are taught sounds first, then names. It shews the exact pronunciation of each word, and a special form of type is reserved for each sound a letter possesses, letters which have no sound being printed in a hair-line or light-faced type. The pronunciation is thus shewn without any change of spelling, and the familiar form of the words as we are accustomed to see them is preserved. In Boston, where the children have not more than four or five years' schooling, the uniform result is a saving of half the time, two years' work being done in one. Difficulties have vanished before experience, and the teachers universally approve.

Writing. The writing in the schools is round and legible, but fine, and consequently lacking in boldness. At the same time nothing is to be seen among the girls of those angular hieroglyphics so common in English ladies' seminaries.

Gymnastics. The good order spoken of above is promoted by the gymnastic and calisthenic exercises practised by the scholars. It seems strange that there should have been any hesitation about admitting these into the programme of studies in Massachusetts, when the importance is considered of bodily exercises as a means of securing the health of the young. We may draw a hint of some value from the musical accompaniment which gives, in the American schools, much more of precision and interest to the drill and marching than such exercises would otherwise possess.

Music.

Drawing. Drawing owes much to the labours of Mr. Walter Smith, formerly of South Kensington, who was charged with the organizing of instruction in this department in the State of Massachusetts, and whose influence is everywhere acknowledged to have been of the utmost value. He refused to admit the common excuse that there was no taste in the people for drawing, and in his system set every child to the tracing of geometrical lines and simple objects, drawn by the eye or imitated from memory. There is indeed a danger lest the young should fall into a servile and lifeless style of copying, the models being as a rule too small; but Mr. Smith's labours are viewed with a strong hope that they will result in the training up of a host of skilled artists and of women able to design.

Needlework. The practical department of needlework is made obligatory in almost all girls' schools, and large volumes of specimens were submitted to us, upon which the kind assistance of Mrs. Brown and other ladies in Philadelphia enabled us to form an intelligent opinion.

Natural science. Great attention is given to elementary natural science, and one of the most interesting features of the display was a number of collections in botany, ornithology and geology, made by scholars, not as curiosities, but as a part of their regular school-work, and as a result of intelligent training. Several States indeed make a habit of supplying such collections to all their schools, just as they do libraries.

Religion. The religious teaching given is of the simplest kind. With certain exceptions, like that of St. Louis, the Bible finds its place as the foundation and authority of moral training, as sufficiently appears from evidence recently given by the Hon. Mr. Northrop. The law, however, strictly enjoins that teachers are to limit themselves to inculcating "piety, justice, respect for truth, "love of country, goodwill towards men, sobriety, industry, charity, patience, "and all other virtues that form the adornment of society and the basis of the "State."

(2.) Secondary or high schools. The grammar schools do not need special notice as they are but higher grades of the elementary. But of the secondary and higher schools, which are analogous to our own English grammar schools, many excellent specimens were shown us through their plans, reports, and samples of work. The system adopted in Michigan and St. Louis is remarkably good, the specimens exhibited being the result of examinations in map-work, free hand mechanical and industrial drawing. New England and the State of New York were conspicuous in this department, while of single cities Worcester, Hartford, Boston, Cincinnati and Manchester deserve special mention, with the incorporated Academies of Andover and Exeter. The first two of these have recently

erected high schools, with one male teacher each, the rest being lady professors, one of whom teaches Algebra, another Latin, a third Greek, and a fourth French.

The risk in these high schools is lest the wide range of subjects should encourage a superficial habit of study, and care needs to be taken in the bestowal of rewards to recognize thoroughness rather than display. The rewards are not few; in New York State alone there are, in addition to exhibitions tenable elsewhere, 128 free scholarships to the Cornell University open to competition among the pupils. Scholarships.

Schools of this class are in most cases fitted up with a generosity little known in England. Text books and libraries of reference are supplied in abundance, and philosophical instruments are not unfrequently voted to the value of 400*l*. A pleasant picture of the interest taken in scientific studies is afforded by the geological parties formed in many of the high schools during the vacation under the care of young professors. One such was led even by a man like Professor Agassiz; it consisted of 40 teachers, selected out of a hundred who volunteered; the party kept "summer school," camping out, carrying provisions, and studying the rocks. "Summer school."

(3.) Normal schools. Normal and professional schools are rarer than they should be. It follows from what has been said of the slight esteem in which teaching is held, that teachers will not care to undergo a course of rigorous preparation for positions they intend to occupy only temporarily, and thus one can understand how, even in Massachusetts, not more than one teacher in four has attended a normal school. This institution is, as a rule, purely for the training of females, and here they find their only opportunity of learning the art of teaching unless in casual assistance as "supplies." In the Northern States, however, increased attention is being paid to this subject, and the establishment of normal schools is becoming popular. There is one at Providence, Rhode Island, with 13 lecturers and 156 pupils, the course being two years; tuition is given free to such as complete the course and become teachers in the State. Five schools of this kind are found in New York, all excellent. Pupils from the higher schools are well trained in the art of teaching, making their first attempts in the practising schools attached, and become familiar with the best systems. Millersville (Pa.), Bridgwater, Salem, Cookstown, Albany and Oswego have done well in this department.

Voluntary teachers' institutes. An informal kind of normal school is constituted by numbers of teachers who, feeling their early disadvantages, voluntarily sacrifice a couple of weeks of their summer holiday for the purpose of obtaining special instruction. They meet in some central town, make their arrangements for board and lodging, and form themselves into classes, accepting lessons from head teachers in the very subjects they are about to teach in their schools. One such voluntary institute I had the advantage of witnessing at Cleveland.

(4.) Technical education. From all parts of the Union comes testimony in favour of technical education, and a desire for its development. At Boston has been founded the Massachusetts Institute of Technology, one of several buildings erected under an Act of Congress of 1862, which appropriated public lands to each State for the support of such schools at the rate of 30,000 acres to each representative in Congress. Thus New York has a million acres in the Western States, Connecticut 180,000, and Michigan 200,000, held on warrants which are saleable, and supply the income required. It is left to each Legislature to apply its fund as it likes. In the exercise of this power Michigan has established an agricultural school, Massachusetts has divided its share between a college of agriculture and one of mechanical art, while that of Missouri, a district rich in minerals, is devoted to agriculture and mining. In some instances classical studies have come in for a portion of the benefit, and in the Northern States increased heed is being paid to drill and military tactics, from a conviction formed since the war that the South is ahead in this respect.

Technical exhibits. Among the technical exhibits the place of honour belongs to the Boston Institute of Technology, closely followed by the Industrial University of Illinois, by Cornell University, and the Worcester Industrial Institute. The population served by the last-named of these is engaged in the iron and wood manufactures, and accordingly stress is laid in the curriculum on a theoretical and practical acquaintance with civil engineering, chemistry, and drawing.

The best industrial schools especially connected with drawing are at Cincinnati, St. Louis, Columbia, and Chicago; and here, as in the primary schools, the influence of South Kensington has been felt for good.

(5.) School buildings; a hundred years ago.

The progress made in school buildings is well shown by a contrast between a school of to-day and one of a hundred years ago. The Exhibition contained a log-hut school, furnished in every respect after the fashion of 1776, and hence contemporary with the village hedge school of England. The walls were formed of trunks of trees loosely put together; the forms were narrow, and without backs; the tables rough, and with no bar for the feet to rest upon. There was a Bible in old characters, an A B C, a primer, a pail of water, with a gourd for drinking cup, and the inevitable birch, supplemented by a stout leather strap, which was subtly divided at the end into four lashes. Such was the furnishing of a common school in the days of George Washington.

The modern school-house at Boston;

Now things are very different. The Boston schools are well known. They are built very much on the Saxony model, with six rooms on a floor, each block of two rooms being separated from the next by a staircase in one direction, while in the other a corridor runs the entire length of the building. Each child has a provision of 16 feet super, or nearly twice the English allowance. Every room is built for 56 children of both sexes, and in each is a female teacher but no monitor.*

and generally.

The ordinary modern school-house, however, was shown in the Exhibition; a stone built structure with high pitched roof, prolonged downwards into overshadowing eaves. At the entrance two porches give access to vestibules where boys and girls deposit their cloaks and hats. The class-rooms are spacious and lit by three windows on either side. A dado two feet high runs round the room and above it a ledge four inches wide for chalks and sponges; then a surface of cement four feet high terminating in a wooden cornice. The cement is hardened with a solution of silica and lamp-black so as to form a continuous black-board round the room. At the further end is the master's platform, and behind it are cases to contain the library and collection of objects in natural history or geology. There are no lavatories; all the children are supposed to come clean.

Some schools defective;

Most of the new schools may be said to be thoroughly good, but there are many exceptions in the country districts. This Mr. Philbrick freely admits when he says "our school-houses are, to a certain extent, our glory and our shame." The school committee at Lichfield in New Hampshire regrets the "slight interest taken in education," and adds "this is in New England, where "the Common School system is supposed to be the *one* cherished institution "which lies nearest every heart. Nevertheless your children are kept during "the cold winter days in buildings which are less comfortable than those which, "if you do not, you should provide for your cattle." A new school at Concord may serve as an example of arrangement. The two lower rooms are used, one as an intermediate, the other as a primary school. The second floor is devoted to grammar school purposes; while the assembly hall in the third story is used for general exercises. The new Ash Street School at Manchester (N.H.) has cost \$65,000, with accommodation for 368 pupils, the cost per child being about 35*l*. It is in the shape of a Greek cross, the arms being 88 feet long and 32 feet wide, with towers 18 feet square. It contains eight class-rooms and is fitted throughout with speaking tubes and electric bells.

others complete and costly.

Lack of space.

New York in many cases sacrifices the essentials of a school, viz., air, light and the due arrangement of class-rooms in order to secure a handsome assembly hall.

It is much to be regretted that in many cases sufficient ground has not been purchased at the outset, and that in consequence the children have no space for recreation, and the schools are dark and confined. Could their builders have foreseen the growth of population they might easily have guarded against this. The Chicago Board of Education built schools when land was worth nothing and hence they enclosed nothing. At Syracuse, in 1825, there was but one house in the place; now there are 50,000 people, and land is most difficult to obtain. Such examples should be a warning to the Western States. The example of the School Board for London may also be of service, the plans

* E. R. Robson, *School Architecture*.

exhibited of buildings erected by its architect, Mr. Robson, showing that in all cases space has been acquired for play ground.

(6.) School fittings. Desks. The school houses now described are admirably fitted. Desks in oak or birch and of various designs were exhibited at Philadelphia. The single desk is everywhere admitted to be the best; and where space can be afforded, English schools would do well to provide it for the higher standards, though of course wood is far dearer with us than in Sweden or America. No doubt the joint teaching of the sexes has been used as an argument in favour of separate desks. It must be added that the desks are kept remarkably clean; even after long use they are free from the ink stains which so deface English schoolrooms.

Pianoforte. The organ or pianoforte is a regular part of American school furniture and earns its place well by the aid it renders to the musical and gymnastic exercises of the pupils. The walls are bright with maps and pictures; here is a collection of minerals, there a magnet, a prism, a microscope with slides. The thermometer and barometer are not absent; here is a stereoscope with views of different lands, and there a magic lantern to be used for school entertainments. Illustrative apparatus. The illustrative apparatus is in general very good; if it be defective, the committee insert in its report a sentence like the following, and what is needed is soon provided:—"A very few cents for each rate or tax payer would put "all the necessary apparatus into our common schools, and we should reap "a hundred fold from the intelligent eye of little ones as they sparkle de- "lightedly on coming home with an exact idea of a 'round word,' and 'four "times four *are* sixteen, and *I know why*.'"

Cheerfulness. Cheerfulness is studied as in itself a help to education; drinking fountains in the centre of the schoolroom are common, the very sinks are of marble, flowers stand on the teacher's table, and sensible mottoes fringe the walls.

(7.) Publications. Primers. The number and variety of educational publications in the United States is astonishing. As it is left to the distinct boards and townships to select their own class books, and no uniform course of instruction is pursued, it follows that almost every publishing firm has its series of readers, geographies, copy-books and the like, and that a good deal of rivalry, not to say jealousy, exists. Some manuals hold their own, despite all competition, like the *Elementary Speller*, a book older than the century, and of which over fifty million copies are believed to have been issued. Dictionaries. The battle of the dictionaries is almost as hot as that of the desks, and the States seem to be divided into two camps, commanded respectively by Webster and Worcester, whose works are everywhere to be seen in all shapes and sizes. Prominent exhibits. The great houses of Lippincott, Appleton, and Harper vied with one another in their display of handbooks of science and literature suitable for schools. The show made by Messrs. A. S. Barnes, the publishers of the *National Teacher's Monthly*, excelled as strictly educational. Prices, however, range high, a dollar and a half being no uncommon charge for an advanced school reader.

Copyright. The Centennial, amongst other advantages, was productive of two Conferences, one dealing with the question of International copyright, and the other with that of public libraries. With respect to the former no conclusion was arrived at; but it is important to note that Canadian publishers are beginning to dispute with American houses the reproduction of English works in a cheap form, one firm at Detroit having offered to make arrangements with English authors by which American reprints will be shut out. Free Public Libraries. At the Conference of Librarians most interesting evidence was given of the extension of free public libraries in the United States. There are now nearly 4,000 such institutions containing over 12,000,000 of selected works, besides 50,000 belonging to schools with about 6,000,000 volumes. For example, all the principal cities are thus provided, San Francisco having 28, Washington 52, Chicago 24, Baltimore 37 (in addition to the Peabody Library of 57,000 volumes), Boston 69, Philadelphia 102, and New York 122.

Maps. The maps and charts exhibited were remarkably full and accurate. Indiana and Winsconsin showed well in this branch, and Ohio gave a tabulation of the minutest details of life in the States, showing the proportion of students and the numbers engaged in various studies. St. Louis exhibited a "block report," giving the residences of all the pupils in its schools, and a shaded map which enabled the visitor to see at a glance where new population was rising, and where schools needed to be provided. Statistical atlas. The statistical atlas com-

piled by Professor Walker gives a perfect mine of information by means of a series of ingenious maps. I subjoin three squares from map No. 32, showing the proportion of inhabitants in the United States as a whole, and in a single Northern and Southern State, employed in various gainful occupations or in attending school.*

Conclusion.

In concluding this report to your Lordships, it may be said that America has reaped the advantages of education in the quickened intellect, widely diffused information, general sobriety, and trained mechanical skill of her citizens. This it is that has supported her in every department of commerce and art, and given backbone and fibre to her national life.

Defects of American schools.

Three questions are at present under discussion amongst educational reformers in the United States:—The maintenance of the primary school as a distinct grade, the apportionment of children to teachers, and the regulation of salaries. But I have ventured to touch upon matters of greater moment in referring to the lack of a central authority and uniform system of thoroughly graded schools, to the absence of an infant department, and to the dearth of qualified masters. These defects are recognized by the Americans themselves, who are keen observers of their institutions, and go far to disarm criticism by their frank avowal of shortcomings.

Their excellences.

They have, however, much to be proud of in the possession of excellent buildings, admirably fitted, of adult teachers for all classes, and best of all in having a strong public opinion in favour of regular attendance, and the liberal support of the common schools.

Great Britain and America.

The mottoes of the two countries are identical. In America it is "the education of the people by the people and for the people;" in Great Britain "the education of the people's children, by the people's officers, chosen in "their local assemblies, and controlled by the people's representatives in "Parliament."†

On the whole, England has nothing to fear in fair competition with America. Visitors from the States admit our schools in the large towns to be on a level with theirs, and are as anxious to learn from us as we should be to copy the excellences of their system. Towards enabling us to do this, the Centennial Exhibition at Philadelphia has rendered notable service.

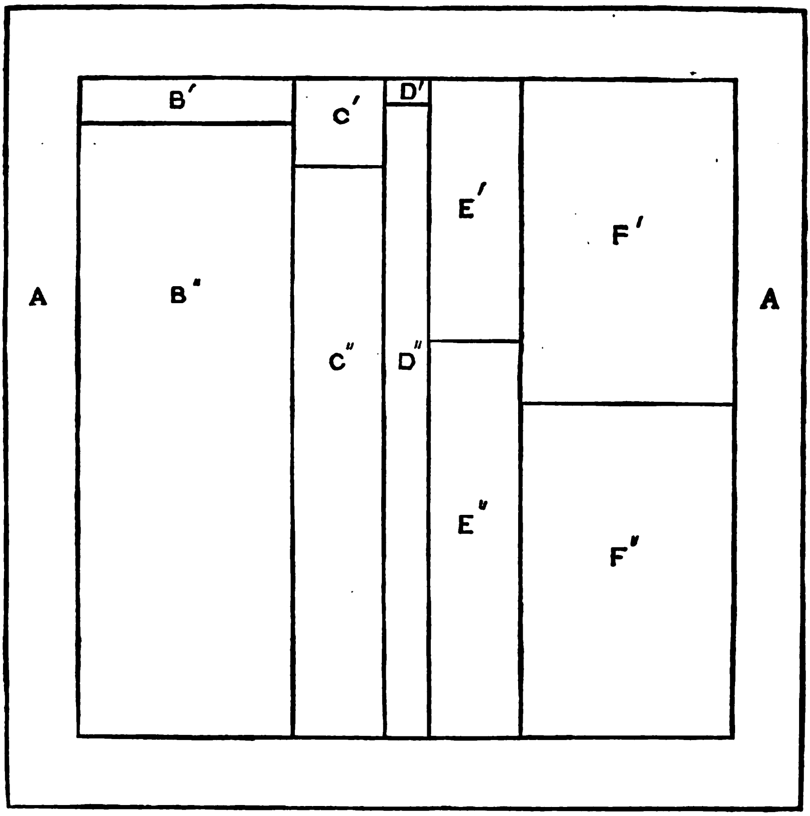
I have the honour to be, &c.

CHARLES REED.

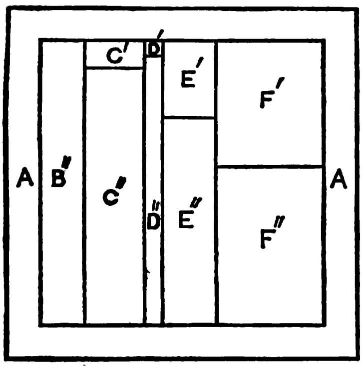
To the Right Honourable the Lords of the
Committee of Council on Education.

* See diagrams at the end of the present report.

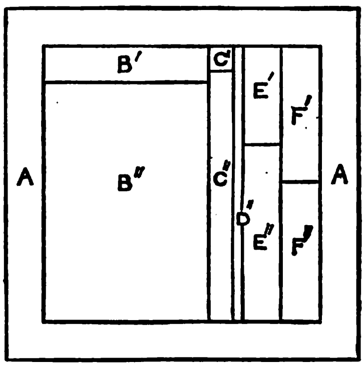
† Report of the Schools' Enquiry Commission, 1867, p. 640.



THE UNITED STATES.



PENNSYLVANIA.

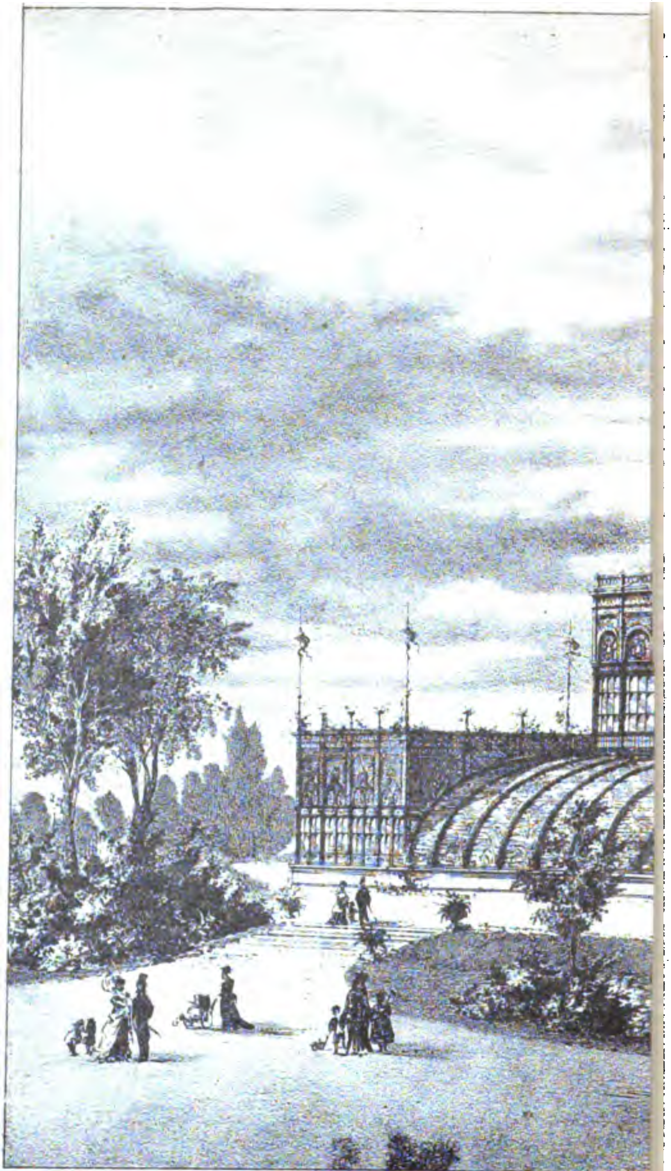


FLORIDA.

A = proportion of population not accounted for.

The inner squares give proportion of population engaged in gainful occupations, or attending school.

B′ = females engaged in agriculture.
B″ = males „ „
C′ = females engaged in manufactures and mining.
C″ = males „ „ „
D′ = females engaged in trade and transportation.
D″ = males „ „ „
E′ = females engaged in personal and professional services.
E″ = males „ „ „
F′ = females attending school.
F″ = males „



Length 350 Feet
Breadth 160 "
Height 65 "

FAIRMOUNT PARK

ADDITIONAL EXHIBITIONS.

Mr. THOMAS DUCKHAM.

CATTLE.

Report on the Cattle exhibited at the Live Stock Show held in connexion with the Philadelphia International Exhibition, 1876. By Thomas Duckham, Esq.

To His Grace the Duke of Richmond and Gordon, K.G., Lord President of the Council.

My Lord Duke,

Preliminary remarks.

In the discharge of the honour conferred upon me by your Grace's appointment as Judge of Cattle at the International Live Stock Exhibition at Philadelphia, I have to report that, with the exception of two Holsteins and one Brittany, the whole of the breeding animals exhibited consisted of the leading English, Scotch, and Channel Island breeds, many of them of very superior excellence.

The distinctive breeds appear to readily acclimatise, retaining their distinguishing character, form, and quality in a highly satisfactory manner, some of the exhibits bred from Imported Stock surpassing in excellence recently imported specimens.

Although the Exhibition was an International one, the only foreign exhibits consisted of five of the Shorthorn breed sent by Mr. St. John Ackers, Prinknash Park, Gloucester. There were several exhibits from Canada, and my report would not be complete were I to omit a special notice of the superior excellence of many of them from the Dominion, as being of the highest order of merit.

Causes of absence.

It will be seen from the annexed schedule that nearly one-third of the animals entered in the Official Catalogue were absent. Possibly that may be attributable to the fact, that the various State and County Shows in the United States and Canada were being held at the time of the Exhibition, and as handsome money prizes were offered at those shows, they proved to be more attractive to some of the exhibitors than the awards of medals and certificates of honour, offered as the reward of merit by the Centennial Commission.

Schedule, entries and exhibits.

Schedule of Entries and Number of Exhibits.

Breed.	From the United States.		From Canada.		From Great Britain.		Total number of Entries.	Total number of Exhibits.
	Bulls.	Cows and Heifers.	Bulls.	Cows and Heifers.	Bulls.	Cows and Heifers.		
Shorthorns	18	57	13	25	3	3	119	96
Herefords	9	27	5	6	—	—	47	33
Devons	17	48	2	1	—	—	68	21
Holsteins	2	3	—	—	—	—	5	2
Guernseys	1	4	—	—	—	—	5	4
Jerseys	51	119	—	—	—	—	170	142
Alderneys	1	4	1	5	—	—	11	6
Ayrshires	15	47	8	21	—	—	91	57
Galloways	1	4	1	4	—	—	10	5
	Oxen and Steer.	Cows and Heifers.	Oxen.	Cows and Heifers.				
Fat Cattle	18	6	3	2	—	—	29	13
Draught Cattle	Yoke of Oxen. 13	—	—	—	—	—	13	9
Miscellaneous including two Bisons	—	—	—	—	—	—	5	3
Total number of entries and exhibits							573	391

Shorthorns.

The Shorthorns were first in order on the catalogue, and the classes contained many animals of high merit; a striking feature in this part of the Exhibition was the preponderance of red, red and white, or red roan animals, as compared with white or the rich roan so generally admired in England. With the exception of those from Mr. Ackers the whole of these exhibits appeared to have been so well cared for that their coats were as short and sleek, as neatly groomed well kept hunters. In that respect those from Prinknash Park looked to advantage with their soft glossy hair and mellow skins.

Herefords. The Herefords were next in order. In their classes there were several very choice specimens presenting that uniformity of character, constitution and quality which has gained for them many admirers, and it was apparent that they are well adapted for the country.

Devons. The Devons were not up to the same standard of excellence as the preceding classes. Yet there were some choice specimens exhibited.

Jerseys. The Jerseys were the most numerous of any of the classes, and it was evident that great care and judgment has been exercised in their selection, and that subsequently great attention has been paid to their breeding and management. They formed a grand feature of the exhibition, and occupied the judges several days in making their awards.

Ayrshires. The Ayrshires were the only other important classes, and included some exquisite specimens.

Draught cattle. The Draught Cattle were cross-breds, either Shorthorn, Hereford, or Devon, from grade cows. Their strength was most severely tested by attaching them to a loaded sledge of the enormous weight of five tons. The greatest weight was moved by a pair of cross-bred Shorthorns; these animals were of immense size, and weighed 4,798 lbs.

Canadian report. I also beg to inform your Grace that the Canadian Commission placed in my hands the awarding of Silver and Bronze Medals in each of the Cattle classes exhibited from the Dominion, and Gold Medals as Champion prizes for the best Bull, Cow, or Heifer in any of the classes of the meat-producing breeds, viz., Shorthorns, Herefords, Devons, or Galloways; also for the best Bull, Cow, or Heifer in any of the classes of the milk-producing breeds, viz., Alderneys or Ayrshires. I therefore submit my Report upon the Canadian Exhibits.

Shorthorns. Awards. The Shorthorns. With the exception of one Bull, the whole of the 38 animals entered competed. The red bull, "Lord Aberdeen," bred and exhibited by Messrs. Hunter of Alma, Ontario, is a fine specimen and well merited the Silver Medal. I may add the highest Certificate of Honour was awarded to him at the International Exhibition. Mr. Boak, of Hornby, Ontario, obtained the Silver Medal in the next class with his imported roan Bull, "Duke of Cumberland," an extremely heavy fleshed animal not quite, I therefore submit, equal to "Lord Aberdeen" on his chine or spring of the rib, but with better rounds and of good character. Mr. Russel, of Richmond Hill, Ontario, was first in the younger class with his red Bull "High Sheriff the Second." He is an animal of great promise. "Isabella," a roan Cow, and another of Mr. Russel's, was not only the gem of the Shorthorns, but she obtained and well merited the Gold Medal as the best breeding animal in any of the classes of the meat producing breeds; her character, form, and quality are of the highest order of merit. "Duchess of Springbrook," a red Cow from the same herd, was a good second and gave evident proof of her very valuable breeding properties in her red roan daughter "Third Duchess of Springbrook," a beautiful Heifer Calf, also a winner of a Silver Medal. Mr. Miller, junior, of Atha, Ontario, had the Silver Medals in the other heifer classes with some very excellent specimens. The choice selection exhibited by Mr. Russel rendered his triumph of the Silver Medal for the best herd of any breed exhibited an easy one; the second prize or Bronze Medal was awarded to Messrs. Hunter's herd.

It is, I consider, worthy of remark that with the exception of one first prize and two third prizes given to animals imported from England, the whole of the other prize winners were bred in Canada.

Herefords. The Herefords. Only four of the eleven entries were exhibited, all of which were bred by their exhibitor, Mr. George Hood, of Guelph, Ontario. His Bull "Hero" is a straight level animal, well covered with flesh, and obtained a high certificate of merit at the International Exhibition. To this was justly added the Silver Medal from Canada. Mr. Hood's Bull-calf "Victor the Third" is a promising animal and displays the valuable breeding properties of his dam "Victoria." To each of these the Silver Medal was awarded.

Devons. The Devons. Only two of the three entries were sent; they were Canadian bred and the property of Mr. Rudd, of Guelph. The medals were awarded, but the animals were not up to the standard of excellence displayed in the preceding classes.

Galloways. The Galloways. Mr. Hood, of Guelph, sent all the entries, all of which were bred in Canada. His Bull "Roger" displays great constitution

and good flesh, and his cow Lady Isabella" is an extremely neat level animal.

The Ayrshires. Only a small proportion of the entries were sent. Mr. Rodden, of Plantagenet, Ontario, had the Silver Medal for his aged Bull "Carrick Lad," and also for his Bull-Calf "General Montgomery." Mr. Thomson, of Bright, Ontario, obtained the Gold Medal for his very choice cow "Mermaid," as the best breeding animal exhibited in any of the classes of the milk-producing breeds. All the animals shown were Canadian bred. Ayrshires.

The Alderneys. One Bull and five Cows, the property of Mr. Rodden, of Plantaganet, Ontario, and all bred in Canada, constituted the exhibits of this valuable race of animals, and the medals were awarded, his Bull "Baronet" and Cow "Maggie" obtaining the silver medals. Alderneys.

Fat cattle. Three Oxen and two Cows constituted the Canadian fat cattle show. In the Ox class the Silver Medals was awarded to Messrs. Satchell Brothers, of Ottawa, for their grand cross-bred Shorthorn Ox; he also obtained the highest certificate of merit at the International Exhibition. His live weight was 2,930 lbs. An extremely level Shorthorn Heifer, exhibited by Mr. Terryberry, of Hamilton, Ontario, very deservedly obtained similar honours at each section of the exhibition. Fat cattle.

I have here to express the valuable assistance rendered us in making the Canadian awards by Mr. W. Birnie, of Springfield, Massachusetts, and Mr. C. Cameron, of Wal-Oak Farm, Marietta, Pennsylvania.

I have the honour to be,
My Lord Duke,
Your Grace's most obedient servant,
T. DUCKHAM.

Baysham Court, Ross.

Mr. OWEN C. RICHARDS.

SHEEP.

REPORT on SHEEP exhibited at the LIVE STOCK SHOW, held in connection with the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876.—By OWEN C. RICHARDS, Esq.

To the EXECUTIVE COMMISSIONERS, 5, Craig's Court, Charing Cross.

GENTLEMEN,

IN accordance with your instructions under date of 30th September 1876, I have the honour to present my Report on the various animals and other matters brought under my notice whilst acting in the capacity of British Judge of Sheep, in conjunction with Mr. P. H. Lannan, of Salt Lake City, Utah, and Mr. Alexander Barrie, of Galt, Ontario, Canada. Judges.

In explanation of the delay in preparing this report, I would respectfully remark that it is in consequence of my having been disappointed by not receiving sundry particulars connected with the awards, which I had entrusted to my Canadian colleague, with the understanding that they should be returned to me long ere this, but which, for some unexplained reason, he has failed to do.

Under these circumstances I have done the best I can with the meagre materials at my disposal, and ask your indulgence in all cases where fuller information may appear desirable.

We commenced our duties on the morning of the 10th October 1876, and continued them until their completion on the 17th of the same month. During that period 295 animals passed under our notice, and may be classified as follows:—

The AMERICAN EXHIBITS, as recorded in Special Catalogue of Stated Displays of Live Stock, consisting of 171 Animals, and comprising— American Exhibits.

No. of Animals.	Description of Breed, &c.	No. of Awards.
8	Of the Lincolnshire breed - - - - -	Nil.
19	Of the Leicestershire breed - - - -	Nil.
29	Of the Cotswold breed - - - - -	Nil.
64	Of the South Down breed - - - -	Nil.
29	Of the Oxford Down breed, to which were awarded—	
	First class certificates - - -	4
	Second class certificates - - - -	5
22	Of the Shropshire Down breed, to which were awarded—	
	Third class certificate - - -	1
171	Animals. Awards	10

The third class certificate was awarded to a three-year old Shropshire Down ram, bred in the United States. Awards.

Of the remaining awards, three first class and three second class were given to animals bred by Mr. A. J. Milton Druce, of Eynsham, England, whilst one first class and two second class were given to those bred by Mr. John Treadwell, of Aylesbury, England.

It may, perhaps, be of some service to state here that many of the awards were given for groupings, and combinations of animals, as well as for single specimens, and that consequently the same animals not unfrequently came up for judgment several times. On the other hand, it sometimes occurred that three, four, or six animals grouped together obtained certain awards.

In justice, therefore, to the total number of exhibits stated above, I have thought it right to give the total number of animals which, in the various groupings, took a part in winning the certificates. Hence, under this section, 171 exhibits are recorded, of which 34 animals obtained awards.

It is only fair to state that many of the four breeds of sheep first mentioned in this report did not put in an appearance; but in the absence of any other particulars I have adhered to the printed special catalogue for guidance as to the number of entries.

Under the American section the exhibits of fat sheep numbered only two pens of three ewes, to one of which was awarded a first class certificate. The

aggregate weight of this pen (Oxford Downs) being 714 lbs. as compared with 488 lbs., the weight of the other pen (South Downs).

Canadian Exhibits.

The CANADIAN EXHIBITS as per same Standard, consisting of 62 Animals, and comprising—

No. of Animals.	Description of Breed, &c.	No. of Awards.
13	Of the Lincolnshire breed, to which were awarded—	
	First class certificates - - - - -	2
	Second class certificates - - -	3
	Third class certificate - - - - -	1
16	Of the Leicestershire breed, to which were awarded—	
	First class certificates - - - - - -	5
	Second class certificates - - - -	2
12	Of the Cotswold breed, to which were awarded—	
	First class certificates - - - - - -	2
	Second class certificate - - - -	1
	Third class certificates - - - - - -	2
21	Of the South Down breed, to which were awarded—	
	Second class certificates - - -	3
	Third class certificates - - - - - -	4
62	Animals. Awards	25

In the Lincoln and Leicester breeds all the exhibits were descended from imported stock, the Rock flock, Scotland, supplying the progenitors in one or two instances, in the latter breed. It is a noteworthy fact that all the animals exhibited under these two breeds took a part in winning the certificates.

In the Cotswold breed Four Ewes which obtained a First Class Certificate (in conjunction with a Ram bred by exhibitor) were bred by Mr. Jacobs, of Gloucester, England. The remainder were descended from imported stock. Under this breed 11 animals out of the 12 exhibited took a part in winning the certificates.

In the South Down breed Seven animals were bred by Lord Walsingham, of Merton Hall, Thetford, England, and imported in 1874. The remainder were descended from imported stock. Under this breed 16 animals out of the 21 exhibited took a part in winning the certificates.

British Exhibits

GREAT BRITAIN EXHIBITS as per same Standard, consisting of 62 Animals, and comprising—

No. of Animals.	Description of Breed, &c.	No. of Awards.
22	Of the Cotswold breed, to which were awarded—	
	First class certificates - - - -	7
	Second class certificates - - -	4
5	Of the Oxford Down breed, to which were awarded—	
	First class certificates - - - -	2
	Second class certificate - - - -	1
	Third class certificates - - - -	2
30	Of the South Down breed, to which were awarded—	
	First class certificates - - -	4
	Second class certificates - - -	5
	Third class certificates - - - -	6
5	Of the Long-Wooled breed, to which were awarded—	
	Second class certificate - - -	1
	Third class certificates - - - -	3
62	Animals. Awards	35

The Cotswold sheep were bred and exhibited by Mr. Russell Swanwick, of Cirencester, Gloucestershire, England, and 18 animals out of the 22 exhibited took a part in winning the certificates.

The Oxford Downs consisted of Five Rams, four of which were bred and exhibited by Mr. Henry Overman, of Weasenham, Brandon, Norfolk, England.

The remaining sheep, namely, a two-years-old Ram, named "Freeland," weighing 380 lbs.! was bred and exhibited by Mr. A. J. Milton Druce, of Eynsham, England. To this animal, without doubt, must be accorded the premier place in the show of sheep, and I certainly think that it is one of the finest animals that I have ever seen.

The South Downs consisted exclusively of animals bred and exhibited by Lord Walsingham, of Merton Hall, Thetford, England.

No. 348 on catalogue, aged 19 months, and weighing 227½ lbs., also No. 350, aged two years and seven months, and weighing 240 lbs., were two very superior animals. Under this breed 20 animals out of the 30 exhibited took a part in winning the certificates.

The Long-Wooled consisted of Five Cotswold Rams, bred and exhibited by Mr. Hugh Aylmer, of West Dereham Abbey, Norfolk, England. Four animals out of the five obtained awards.

Happening to have the weights of these by me, it may not be uninteresting to state them. Nos. 368, 369, 370, and 371 on catalogue weighed respectively 291 lbs., 284 lbs., 277 lbs., and 318 lbs.

A Prize of 100 Dollars, given by the Pennsylvanian Agricultural Society, for the best pen of sheep, consisting of Four breeding Ewes and One Ram, of the Shropshire, Oxford Down, and South Down breeds. Three competitors. Prize awarded to Mr. T. S. Cooper, of Coopersburg, Pa., for a pen of the Oxford Down breed, imported from the flock of Mr. A. J. Milton Druce, of Eynsham, England. $100 Prize.

A Sweepstakes of six competitors, for the best pen of Three breeding Ewes of the Middle-Wooled breed. Prize awarded to Mr. T. S. Cooper, of Coopersburg, Pa., for a pen of the Oxford Down breed, imported from the flock of Mr. A. J. Milton Druce, of Eynsham, England. Sweepstakes.

A Sweepstakes of 13 competitors, consisting of six South Downs, five Oxford Downs, and two Shropshires, for the best Ram of the Middle-Wooled breed. Prize awarded to "Freeland" (of the Oxford Down breed), being the property of Mr. A. J. Milton Druce, as before stated. Sweepstakes.

A Prize of 100 Dollars, given by the Pennsylvanian Agricultural Society, for the best pen of sheep, consisting of Four Breeding Ewes and One Ram of the Long-Wooled breed. Five competitors. Prize awarded to Mr. Russell Swanwick, of Cirencester, Gloucestershire, England, for a pen of the Cotswold breed. $100 Prize.

A Sweepstakes of four competitors, for the best pen of Three breeding Ewes of the Long-Wooled breed. Prize awarded to Mr. Samuel Langford, of Granton, Ontario, for a pen of the Lincolnshire breed, descended from stock imported from England in 1872. Sweepstakes.

A Sweepstakes of two competitors, for the best Ram of the Long-Wooled breed. Prize awarded to a two-years-old sheep of the Lincolnshire breed, belonging to Mr. Samuel Langford, of Granton, Ontario, and bred from stock imported from England in 1872. Sweepstakes.

INTER STATES COMPETITION.

Inter States Competition.

Long Wools.

For the best group of Six breeding Ewes and One Ram. Competitors (Great Britain and Canada). Prize awarded to Canada for a group of four Lincolns, two Leicesters, and one Cotswold. Prize.

Middle Wools.

Prize.

For the best group of Six breeding Ewes and One Ram. Competitors (Pennsylvania, Great Britain, and Canada). Prize awarded to Pennsylvania for a group of Oxford Downs, imported from the flock of Mr. A. J. Milton Druce, of Eynsham, England.

Certificates.

In accordance with the instructions of the Executive of the International Exhibition, the original Certificates of Merit, which were duly signed by the judges, and awarded in the place of the medals usually given at kindred Exhibitions, were worded after the following manner, instead of being simply termed first, second, and third class :—

(1.) "For high excellence in quality, uniformity of symmetry, large constitutional development, and for being a very superior specimen of the breed to which it belongs."
(2.) "For being a first-class specimen of its breed."
(3.) "For being an excellent specimen of its breed."

A perusal of the foregoing statements will, I imagine, lead to the observation that almost all the best animals were either imported direct from England to the Centennial Exhibition or else were bred from stock imported from this country within the last few years by some of the more enterprising States.

Successful breeds.

The breeds which appear up to the present time to have been most successfully used by the different States are the Lincolnshire and the Cotswold.

Canada, in particular, exhibited some very fine animals of both these breeds, whilst Great Britain, as a matter of course, was not unworthily represented.

Amongst the other British exhibits, the Oxford Downs, which were of an exceptionally fine character, appeared to attract the especial notice of the Americans, on account of their great size, combined with good quality.

I must not omit to mention the South Down exhibits of Lord Walsingham, as, in addition to those animals already noticed in another part of this report, two or three pens of ewes were, in every respect, most worthy representatives alike of their country and their noble owner.

The Shropshire Down exhibits were of a very inferior class, bred in the States from stock imported from this country in 1861. They seem to have increased in size at the sacrifice of quality both of flesh and wool, evincing thereby, in my opinion, the necessity of a change of blood.

It was a source of great regret to the Americans that there were no British specimens of the Shropshire Down and Hampshire Down breeds at the Exhibition, as they had been led to expect by the ordinary catalogues. In fact I am in a position to say that many breeders attended the Centennial for the express purpose of studying these types.

Short professional tour.

In approaching the subject of my general impressions, formed on a rapid tour around what I may term the chain of lakes adjacent to the scene of our labours, I am forcibly reminded of the obligations I am under to Colonel Sandford, as the acting British Executive Commissioner at Philadelphia, for his uniform courtesy throughout my visit, as well as for the special facilities for undertaking this journey, which his influence was the means of obtaining for me.

I wish also, whilst writing on this subject, to express my best thanks to all branches of the Executive for the valuable assistance so readily accorded on all occasions.

Systems of Farming.

In the course of my tour I visited Pittsburg, Cressline, Chicago, Buffalo, Niagara, Toronto, Lake Ontario, River St. Lawrence, Montreal, Providence (Rhode Island), Boston, and New York. Whilst going this circuit I had an opportunity to observe the systems of farming in vogue in those districts. I must say that, from a sheep-farming point of view, I came to the conclusion that the want of proper shepherding and attention were two fruitful sources of the disappointing results which sometimes attended the importation of good and expensive stock. The almost total absence, too, of the customary root crops of England, which I am told is in consequence of the long and severe winters which they experience, does undoubtedly militate greatly against the indiscriminate use of English-bred stock.

Under these circumstances I incline to the belief that the larger breeds of sheep are the better suited to the peculiarities of the country.

The Merino sheep appear to be kept in by far the largest numbers around these parts, being of course valued principally for their wool-growing qualities. **Merino Sheep.**

From a consumer's point of view I can testify to the marked superiority of our English mutton over that obtained from this class of animal.

In passing through the principal park of New York my attention was drawn to the novel sight of, what appeared to me at a distance to be, a first-class flock of sheep of about 100 in number. In order to obtain a closer view of them I was guilty of trespassing over the forbidden parts, and, my official capacity being unknown, incurred for the moment the displeasure of a policeman and the shepherd. My favourable impression was strengthened on getting nearer, and I may truly state that they were equal to anything which I saw at the Exhibition coming from the States. They were Shropshire Down Ewes, presented to the representatives of that city by some liberal Englishman several years previous. **Central Park, New York.**

I was, however, much astonished to hear the shepherd style them South Downs, and it required all the weight of my supposed knowledge as British Judge to make him think otherwise. To carry out this mistake, a thing, purporting to be a South Down Ram, was turned with them, which, in every respect, seemed outrageous. I could not help thinking that if the case were made known to some of our English breeders of Shropshire Downs only too many of them would be anxious to present the said city with rams worthy of the flock already in its possession. Following the directions of the policeman I inspected, in another part of the park, some 50 ewe tegs, descended from these sheep; and the two lots taken together were the best animals that I saw in the course of my tour.

Before closing my report I am prompted to say that, in my humble opinion, much of the interest usually displayed in Live Stock Exhibitions was removed by the circumstance of the different classes of stock not being on view at the same time. **General remarks.**

In short, I am constrained to admit that I, individually, experienced some feelings of disappointment when I discovered that I should be denied the pleasure of inspecting the Horses and Cow Stock, which always possess such attractions for me.

Trusting that the foregoing report is such as you require,

I have the honour to be,
Gentlemen,
Your obedient humble Servant,
OWEN C. RICHARDS.

2, Eton Villa, Blandford, Dorset,
6th December 1876.

MR. G. W. BAKER.

SWINE.

REPORT on SWINE, exhibited at the LIVE STOCK SHOW, held in connection with the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By G. W. BAKER, Esq.

GENTLEMEN, Luton Hoo Park, Nov. 28th, 1876.

I HAVE the honour to report that I attended the International Exhibition at Philadelphia on the 10th of October 1876, agreeably to your instructions, as British Judge of Swine, and that I acted in that capacity with Colonel W. Rhodes, of Quebec, and Mr. J. M. Washburne, of Sioux Falls, Iowa, and that we commenced our duties, as instructed by General F. A. Walker, Chief of the Bureau of Awards, and Captain Landreth, Chief of the Bureau of Agriculture, on the following day, when 211 animals were placed under our inspection, viz. :— Judges.

American Exhibits consisting of— American Exhibits.

126 animals that were bred in the United States, to which were awarded - - -	17 First Class Certificates. 14 Second ditto. 5 Third ditto.
48 animals that were bred in England by Earl Ellesmere, Lord Leigh, Mr. Russell Swanwick, Mr. Jacob Dove, Mr. H. Humfrey, Captain A. Steward, &c., to which were awarded - - -	25 First Class Certificates. 8 Second ditto. 2 Third ditto.
6 animals that were bred from Imported Pigs, to which were awarded - - -	3 First Class Certificates. 1 Second ditto.
180 Total American Exhibits.	75 Total of American Awards.

Canadian Exhibits consisting of— Canadian Exhibits.

7 animals that were bred in Canada from Native Herds, to which were awarded -	4 First Class Certificates.
18 animals that were bred in Canada from Imported Pigs, to which were awarded -	14 First Class Certificates. 3 Second ditto.
2 animals that were bred in England by Mr. Peter Eden and Mr. W. Parker, to which were awarded - -	2 First Class Certificates.
27 Total of Canadian Exhibits.	23 Total of Canadian Awards.

Great Britain Exhibits consisting of— British Exhibits.

4 animals that were bred in England, by Mr. Benjamin St. John Ackers, to which were awarded - -	3 First Class Certificates.
4 Total of Great Britain Exhibits.	3 Total of Great Britain Awards.

A Prize of $100 given by the Pennsylvania Agricultural Society for the best Herd of Swine. Best Herd of Swine.

Prize awarded to Mr. T. S. Cooper, of Coopersburgh, for two Berkshire Boars, bred in England by Mr. Heber Humfrey, and six Berkshire Sows, bred in England by Mr. Russell Swanwick, Mr. Matthew Walker, and Mr. John Walters. Three herds competing.

Best Sow, any Breed.

A Sweepstake with 15 competitors for the best Sow of any breed.

Prize awarded to Mr. T. S. Cooper, of Coopersburgh, for his three years Berkshire Sow, bred by Mr. Matthew Walker, of Anslow, England.

Best Boar, any Breed.

A Sweepstake with 14 competitors for the best Boar of any breed.

Prize awarded to Messrs. A. Frank and Sons, of Cheltenham, Ontario, for their 19 mos. Suffolk Boar, bred by themselves from an imported G. sire.

With the exception of the three last awards none of the animals were brought into direct competition with each other, as is usual at all English exhibitions. At Philadelphia the judges were especially instructed to award—

Certificates.

First class certificates to such animals that were considered "superior specimens of their breed";

Second class certificates to those that were considered "first class specimens";

Third class certificates to such as were considered "excellent specimens" of their breed.

Therefore, as the distinctive merits of the several exhibits were submitted to no test, the only way to arrive at the position that England took is by comparing the above statements; viz.,

Per-centage of Prizes. American Exhibits.

The American exhibits show that 28 per cent. of the animals bred in the United States took certificates, that nearly 74 per cent. of those bred in England were successful, and 66 per cent. of those bred from Imported Animals were classed.

Per-centage. Canadian Exhibits.

The Canadian exhibits show that about 57 per cent. of the animals bred from the Native Herds took certificates, that 94 per cent. of those bred from Imported Stock, and all that went from England, were successful.

British Exhibits.

Great Britain exhibits show that 75 per cent. took certificates.

The English animals were fully appreciated by the few persons who attended the stock exhibition, and most of those interested in the production of stock will doubtless encourage the importation of superior animals from England, or from wherever they may be found.

Chester Whites.

The native race of "Chester Whites" is a strong, useful breed peculiar to America, and capable of great improvement by the judicious use of imported Suffolk, Yorkshire, or other superior Boars.

The stock-yard arrangements were very good, and more than sufficient for the accommodation of the animals exhibited in October.

General remarks.

Regret was expressed that the Stock Exhibitions were held at different periods, as the interest of the show was divided thereby, which, added to the stock yard being isolated from Fairmont Park, naturally detracted from its success.

I desire to express my thanks to Colonel Sandford, as the Acting British Executive Commissioner at Philadelphia, for his courtesy and kind assistance, thus enabling me to fulfil, with confidence, the honourable appointment that was entrusted to me.

I have, &c.
G. W. Baker.

To the Executive Commissioners,
5, Craig's Court, Charing Cross.

MR. THOMAS PARRINGTON.

CANADIAN HORSES.

REPORT on CANADIAN HORSES entered for the SPECIAL CANADIAN COMPETITION at the HORSE SHOW, held in connection with the INTERNATIONAL EXHIBITION, PHILADELPHIA, 1876. By THOMAS PARRINGTON, Esq.

To COLONEL H. B. SANDFORD, R.A., Executive Commissioner, British Section, Philadelphia.

SIR,

IN accordance with your request I beg to submit a report of my experience in the examination of the Canadian Horses assembled at the Centennial Exhibition at Philadelphia.

I commenced my inspection of the horses on Tuesday, Sept. 5th, and finished on Thursday Sept. 7th.

I may state that as the horses were not properly arranged in classes, and as the numbers attached to them did not always agree with the numbers in the catalogue, and further, that some of the exhibits were not in the catalogue at all, the difficulty of judging them was materially increased, I trust however I did not pass over any animal worthy of being noticed.

I will begin my remarks by stating what pleasure it gave me to see so many good horses exhibited by the Canadians, and I felt some pride in knowing that nearly all the animals of great excellence either had been imported from Great Britain, or were immediately descended from stock so imported.

In awarding the medals placed at my disposal I beg to make the following remarks:

The Gold Medal, for the Best Heavy Horse sent in, I awarded to a Black Cart Stallion named Young Wonder, belonging to T. and J. Little of Sandhill, Ontario. Young Wonder (a son of an imported stallion I knew when in England,) is 5 years old, 16 hands 3 inches high and weighs 1,792 lb., possesses all the qualities of a sound, active, and elegant English Cart Stallion; a more beautiful specimen I never saw, and the great advantage of breeding from such a horse is this, that a mare of any useful sort mated to him could not fail to breed valuable offspring. Gold Medals.

The Gold Medal, for the Best Light Horse in the show, I awarded to a thorough bred imported Stallion named Warmanbie, 15 years old, by Mountain Deer, the property of William Clark, Greenwood, Ontario. This horse possesses fine quality and general appearance, is sound, and eminently calculated to get good stock, he has unfortunately lost the sight of the near eye, the result of accident no doubt, as the other eye shows no constitutional weakness.

The Silver Medals I have awarded as follows:— Silver Medals.

1. To "Terror," a very beautiful Thorough Bred Stallion, the property of John White of Milton, Ontario. This horse is somewhat light in substance, but very elegant, and full of quality and action.
2. To "British Splendour," a bay English Coaching Stallion, 12 years old, shewn by Andrew Somerville of Huntingdon, Quebec. A very good horse, and most suitable to get mares of substance and appearance to breed from.
3. To "Pat Molloy," a Grey Cart Stallion, 6 years old, 1,788 lb., exhibited by Joseph Fisher, Ben Miller, Ontario. This is a horse of great excellence, and valuable in any country.
4. To "Duke of Newcastle," a bay, 5 years old Clydesdale Stallion. A beautiful specimen of that breed.
5. To "Glory of Dominion," the property of James Swennerton, Exeter, Ontario, bay, 6 years old, 1,810 lb. A horse of fine symmetry, good colour, and certain to get good stock.
6. To "Honest Sandy." A remarkable fine 4 years old Cart Stallion sent in by M. A. Burgess, Weston, Ontario.
7. To "Royal Tom," another very good four years old Cart Stallion, recently imported by W. Long, Lansing, Ontario. He weighs 1,970 lb., is very powerful and active; I knew him to have taken many prizes in England, and I am sure Mr. Long deserves the thanks of his countrymen for introducing such a horse into Canada.

8. To "Glenelg" the property of C. E. Mason, Clinton, Ontario. This is another horse of remarkable excellence; he is sound, has good appearance, great powers, and fine action.
9. To "Jean," a magnificent Clydesdale Mare, the property of James and David Boag of Ravenshoe, Ontario. This mare is 7 years old, 16 hands high, weighs 1,630 lb., with a splendid foal at foot weighing 706 lb. I have no hesitation in pronouncing "Jean" to be one of the best Clydesdale mares I ever saw.
10. To "Fancy," a Yearling daughter of the above-named "Jean." Exceedingly good in all respects, and will make a most valuable mare.
11. To "Fannie," a seven years old bay Coaching Mare, the property of James McDonough, Carlow, Ontario. This mare is in every respect the right sort of animal to breed from, and I trust that there are many of the same type to be found in Canada.

Bronze Medals.

I awarded the Bronze Medals to the following:—

1. To "Marquis," a 6 years old Clydesdale Stallion, exhibited by C. Douglas, Oakbridge, Ontario.
2. To "Dun Donald," an 8 years old Clydesdale Stallion, 1,895 lb., the property of J. and D. Boag, Ravenshoe, Ontario.
3. To "Scotsman," a very useful 4 years old Clydesdale Stallion, exhibited by James McDonough, Carlow, Ontario, 1,890 lb.
4. To "Loch Fergess," a 2 years old entire Clydesdale Colt, 1,654 lb., a very good sort, the property of Edmundson Snyder, Brantford, Ontario.
5. To "Lord Logan," a 3 years old Entire Colt, 1,690 lb., a clean made clever horse. Exhibited by T. K. Hicks, Mitchell, Ontario.
6. To "Young Cumberland," a 5 years old Clydesdale Stallion, 1,460 lb. A good horse on a small scale, the property of James McSorley, Jarvis, Ontario.
7. To "Farmers Fancy," a good 3 years old Clydesdale Entire Colt, 1,610 lb., the property of W. Hurdman, Ottawa, Ontario.
8. To "Gladstone," a brown Cart Stallion of a very useful sort, 6 years old, 1,880 lb., the property of A. Somerville, Huntingdon, Ontario.
9. To "Emperor," a brown Coaching Stallion of considerable merit, exhibited by W. Long, Lansing, Ontario.
10. To "Lord Zetland," a 4 years old half bred Coaching Stallion of a very useful stamp, also shewn by W. Long.
11. To "Black Bess," a very handsome black Cart Mare, 9 years old, 1,604 lb., the property of W. H. Hurdman, Ottawa, Ontario.
12. To "Coldstream Lass," a 3 years Clydesdale Filly, 1,700 lb. A very promising mare, shewn by Brothers Jeffrey, Whitby, Ontario.
13. To "Dash," a bay 2 years old Clydesdale Filly, 1,348 lb., the property of J. Smith, Raglan, Ontario. A very fine and pure bred animal.
14. To "Empress," a 4 years old Clydesdale Mare, 1,642 lb., a very useful mare, exhibited by George Doidge, Columbus, Ontario.
15. To a black Roadster Mare of a good sort, exhibited by Alexander McEwen, Ashton, Ontario.
16. To "Tom and Bill," a Match Pair of 5 years old Lurry or Drag Horses, exceedingly powerful and well matched, the property of J. Smith, Raglan, Ontario.
17. To "Polly and Fan," a very clever Match Pair of light Cart Mares, exhibited by William Gerrie, Dundas, Ontario.
18. To a Match Pair of chesnut Mares, suitable for carriage purposes, 5 years old, shewn by George Carris, Ingersoll, Ontario.
19. To a very beautiful Match Pair of blacks, brother and sister, suitable for a light carriage, exhibited by Halleburton Kennedy, Birr, Ontario.

Summary.

From what I saw of the horses sent to Philadelphia from Canada, I am quite satisfied that considerable judgment and care has been exercised in the breeding and rearing such horses as were brought under my inspection.

I regret that so very few mares were sent to the exhibition, yet several of the right sort were there, and I would observe that there is but one way to raise good stock in any country, viz., by selecting the best mares that can be

procured, and then mating them to sires of known reputation as getters of sound and well formed offspring; the possessor of a really good mare should not be deterred from using good stallions because of the expense, as one good colt is worth twenty moderate ones.

Mares of good form, fine action, with length and substance, are difficult to meet with, such mares are invaluable in any country, and every care should be taken to keep up the supply. I regret very much that in England they are not so easily found as they could be twenty or thirty years ago, and the evil results of this scarcity will be felt for years to come.

In conclusion, I trust I may be pardoned if I offer the same advice to the breeders of horses in Canada that I have done more than once to those in the "Old Country," viz., having got possession of a mare of substance and quality that breeds well, never part with her, send her to the best and most suitable sires, regardless of the cost, take every care of her, and the produce cannot fail to recompense the breeder for his outlay and labour.

T. Parrington.

Helmsley, 25th September 1876.

LONDON:
Printed by George E. Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.